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ABSTRACT

An evaluation is reported of an intensive 15 month non-traditional certification program for secondary teachers in the fields of mathematics, physics, chemistry and earth sciences. The program integrated pedagogical content from empirical, experiential and theoretical perspectives. The rational for developing the progam was that in order to be considered as viable content for a teacher preparation program, the concept, principle or process must be: (1) related to student growth as revealed by empirical evidence; (2) identified as a necessary curricular component by expert opinion based on experience; or (3) logically explained by theory from social science and/or philosophy. Content maps and instructional models are presented along with course offerings. The results of the observations completed for the evaluation are discussed in the areas of: (1) student achievement; (2) teaching practices; (3) reflective thinking about teaching; (4) collaboration between schools and university; and (5) recruitment and selection of interns. Data analyses and subsequent interpretation of the analyses suggested that the efforts to integrate different epistemologies or extant content of pedagogy into an effective teacher preparation program were successful. Included in the appendices is a sample observation form and a copy of the high school biology examination used in the earth science course. (JD)

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Program Assessment Report
Curriculum Evaluation of a Non-traditional Program for Certifying Teachers

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September 27, 1988

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Curriculum Evaluation of a Non-Traditional
for Certifying Teachers

Teacher education takes place in over 1300 institutions of higher education in this country. Yet with few exceptions the nature of the content and corresponding course work of teacher education has changed little in the past half century (Drummond & Andrews, 1980). Typically, secondary teaching candidates complete courses such as introduction to education, general and adolescent psychology, general methods of teaching, and a subject-specific methods course. As the culminating experience teaching candidates in secondary education complete a field experience which is usually student teaching. This stability is incongruent with the expanding knowledge base associated with teaching and additional responsibilities placed on teachers, especially during the past two decades.

Kerr (1983) has posited the stability of teacher education curricula is due to constraints, such as the undergraduate context for preparing teachers. Augmenting the professional component of teaching candidates' undergraduate studies by reducing course work for academic foundations and content specializations has been summarily dismissed because such adjustments would diminish the liberal education of future teachers and certainly not enhance the status of teacher education (Campbell, 1975). Other options for expanding professional curricula include lengthening the time required to complete a baccalaureate degree and extending professional study to the graduate level. While additional time may be essential in providing for a higher quality teacher preparation program, serious consideration of other curricular variables in addition to time needs to be given.

Issues associated with the curricular scope of teacher education content based on empirical evidence, experience, and theory are presented to illustrate the content dimension (Denton, 1987).

Empirical Evidence: Soltis (1984) has noted that educational researchers have imitated methods and form of the natural sciences while seeking knowledge, legitimacy and status. This phenomena has resulted in language and logic of the positivist tradition being integrated into educational theory and practice. Fortunately of late some latitude has been accepted in this orientation allowing qualitative research techniques, e.g., naturalistic descriptions and survey efforts to be included with classical control-treatment group experiments in yielding creditable findings to the literature (Shulman, 1986). Process-product research in teacher education, which incorporates techniques from both qualitative and quantitative research perspectives, has been examined by teacher educators seeking empirically supported concepts, principles, and skills for their curricula. Fry, Smith and Wilson (1984) indicate that a research-validated knowledge base on effective teaching is the basis for the Florida Beginning Teacher Program and the Florida Performance Measurement System. Other writers (Evertson, Hawley, & Zlotnik, 1984; Guyton, 1984; Haberman, 1984; and Koehler, 1983) have suggested that sufficient research evidence is available to guide educational practice. To illustrate, lists of effective teaching practices have appeared in the literature by Good (1979), Good and Grouws (1979), Brophy (1983), Anderson, Evertson and Brophy (1982), and Rosenshine and Stevens (1986). Ironically, these teaching practices are very

similar to the sequence of instructional moves, events-of instruction, presented by Gagne (1970, 1977). It is fortunate these instructional moves (i.e., gaining attention of learner, providing objectives to learners, reviewing prerequisites, providing stimulus material with guidance, requiring learner performance of new learnings, providing feedback, assessing learning based on multiple performances and providing multiple examples and applications for retention and transfer) have been verified by process-product research as well as research from instructional psychology (Gagne, 1977, 1985; Klausmeier and Allen, 1978; Glaser, 1976).

Experience: The precedent for using experience as the basis for selecting content for pedagogy is well documented. Early normal schools relied extensively on the knowledge and judgement of teachers who shared their craft with teaching apprentices under their tutelage. However, Haberman (1984) notes that the ultimate criterion for evaluating experiential knowledge depends on the competence, judgement and wisdom of the individual whose "experience" is being fashioned into a curriculum. When experience is accepted as valuable, it is an acceptance of the individual's expertise. Therefore, a curriculum for teacher preparation based on experience in this sense is also one based on expert opinion. Certainly, the collective experiences of teacher educators have influenced the scope of pedagogical topics as well as the substantial emphasis placed on field experiences in the preparation of teachers. Issues associated with classroom decision-making, instructional planning and reflective teaching emphasize the role of experience as a curricular variable in the preparation of

teachers.

Theory: Concepts from psychology, sociology, anthropology and philosophy represent other sources of content for teacher preparation. Illustrations from sociology and philosophy are presented to convey the nature of pedagogical content derived from this domain.

Principles from sociology and organizational science, which explain how individuals behave in groups and particular social settings, certainly are worthy content for teaching candidates. Sociological principles related to the role of the teacher, how teachers are influenced by their peer groups in the work place, the influence of administrative styles on teachers, and the impact of the community on the professional life of the teacher reflect the range of professional issues addressed by this discipline.

In any teaching encounter, there are philosophical principles and values evident in the choice of subject matter, as well as in the selection and implementation of instructional strategies. The results of teaching can be evaluated in terms not only of the quantity of what is learned but the quality of the learnings as well. Soltis (1984) urges that relevant standards and norms for the qualitative and ethical dimensions of teaching be determined. Currently, this normative dimension of teaching gets little systematic and thoughtful attention yet it continues to influence education just the same. As teacher preparation programs develop strategies to nurture the development of reflective teachers, greater emphasis will be placed on this content domain.

The preceding discussion presents three rationales for selecting

content for teacher preparation curricula. These rationales phrased as decision-rules are: in order to be considered as viable content for a teacher preparation program, the concept, principle or process: (1) must be related to student growth as revealed by empirical evidence; or (2) must be identified as a necessary curricular component by expert opinion based on experience; or (3) must be logically explained by theory from social science and/or philosophy.

Consolidating these decision-rules represents perhaps the most defensible approach for developing a content structure for pedagogy. Validation of content in resulting teacher education curricula would then depend on affirmative responses to two or all three of the decision rules.

Efforts to apply these curricular decision rules have occurred in fashioning a curriculum for certifying teachers in high need areas. Specifically an alternative teacher preparation program was developed for post-baccalaureate students pursuing secondary level certification in the fields of mathematics, physics, chemistry, geology and physical science. The resulting curriculum permits teaching interns to complete concurrently requirements for the Master of Education degree and a secondary teaching certificate in 15 months. An investigation of the effectiveness of this curriculum began when the program was implemented in 1986. The following evaluation questions were phrased to guide this inquiry.

1. Is student achievement on curriculum bound end-of course tests affected by whether the teacher was a teaching intern in the alternative certification program or an experienced colleague of the intern?

2. Do curricular elements of the alternative certification program which emphasize findings and processes of research on teaching influence the teaching practices of teaching interns?

3. Do curricular elements of the alternative certification program which foster reflective thinking about teaching influence the ability of teaching interns to analyze and investigate instructional problems in their classrooms?

4. Do institutional structures and characteristics of individuals affect collaborative efforts between schools and university regarding the alternative certification program?

5. What factors influence the recruitment and selection of teaching interns for an alternative certification program?

Evaluation questions 1, 2 and 3 focus on program outcomes while questions 4 and 5 examine processes associated with implementing the program.

PROGRAM/COMPONENT DESCRIPTION

A brief discussion of the policy and organizational contexts of the alternative certification program at Texas A&M University is presented to convey factors influencing program development.

Policy Context

Consistent with an organizational position favoring centralized decision-making, Texas has enacted a number of education codes which increase accountability of school clients and professionals to the Texas Education Agency. Processes include standardized tests whose results are interpreted to determine learner mastery of the essential elements contained in the state adopted curriculum. In 1984, additional legislation was enacted which affected nearly every aspect of public education including teacher preparation. The concern for teacher quality and accountability was so pronounced that <u>all</u> teachers

under contract were required to satisfactorily complete the TECAT, a standardized test of basic skills of communication (reading and writing) and computation. Failure to complete this examination satisfactorily resulted in the revocation of an individual's teaching certificate.

This legislation also required teacher preparation programs to implement a testing program which included entrance and exit tests. In order to be admitted into teacher education, at present, all prospective candidates must achieve criterion scores on the Pre-Professional Skills Test (PPST) of 171, 172, 173 for mathematics, writing and reading, respectively. Assuming a successful experience with the PPST, the individual is admitted into teacher education and completes the course requirements for the certificate. At the conclusion of the program, the teaching candidate must successfully complete another standardized test, the ExCET examination. On this test, candidates must evidence mastery of pedagogy and their teaching field specialties through meeting or exceeding established cut-off scores. Successful scores on the ExCET examination must be attained before the candidate can apply for their initial teaching certificate. These end-of-program examinations were first administered during the Spring, 1986.

Ironically, while the testing movement gained momentum and sensitivity to quality heightened, the state continued to allow school districts to employ nonqualified individuals to teach with emergency certificates. These individuals simply filed a "deficiency plan" identifying requisite course work needed to complete the teaching

specialty they were being employed to teach. Assuming no qualified candidates were available, these individuals could legally be employed to teach with the emergency certificate for a period up to three years. The PPST was not required of these individuals until Spring, 1987.

Abuses of emergency certificates are far too common. In one instance a school district requested the university to develop a deficiency plan for one of their coaches which would enable him to teach junior high mathematics. Upon examination of the individual's transcript, it was learned he had 3 hours of mathematics credit, 21 hours short of the minimum requirement for a teaching field, yet the district was willing to place him in a mathematics classroom. Had the university complied with the district's request to develop a deficiency plan in mathematics, the coach would have been a legally qualified teacher! A second abuse of deficiency plans is linked to a regulation of the temporary certificate which requires that an individual demonstrate progress in completing courses on the deficiency plan each year. Here, unscrupulous individuals develop a deficiency plan, "teach" the subject they are not prepared adequately to teach, but do not complete any of the stated course deficiencies. At the conclusion of the year, the "qualified" teacher merely moves back into his/her area of certification and the process is repeated with someone else.

While abuses of emergency certification plans are legend, the state has not eliminated this obvious loophole in the certification process. The hypocrisy of the emergency certificate seriously

undermines the effort of the state to raise the quality of education in every classroom.

Organizational Context

Texas A&M University, established in 1876, is among the nation's fastest growing universities. It is a large campus of more than 5,000 acres located in the east-central part of the state in College Station about 90 miles northwest from Houston.

Enrollment in the University exceeds 39,000 with approximately 5% of the students coming from nearly 100 countries other than the United States. There are more than 2,000 faculty members at the university teaching in 78 different departments within 10 academic colleges.

Students may complete studies in many different fields including 95 degree programs at the undergraduate level, 140 at the master's level and 90 at the doctoral level. International applicants are not admitted to the University as non-degree students (Harris, undated).

The College of Education includes 7 departments whose primary functions are teaching, research and public service. The main teaching role of the college is to serve as a professional school for the preparation of elementary and secondary school teachers, with particular emphasis on teaching in the State of Texas. Presently the College of Education has an undergraduate enrollment exceeding 2,400 students. The number of students completing the requirements for Texas teaching certificates exceeded 450 in 1986.

Among recent enrollment figures are substantial numbers of teaching candidates with teaching fields in mathematics and science. Spring, 1987 enrollment figures included: 241 - mathematics, 103

biology, 42 - chemistry, 28 - earth science, and 16 - physics (Romig, 1987) . In fact, Texas A&M was credited with preparing more mathematics and science teachers in 1986 than any other college or university in the United States.

Extensive research and evaluation of teacher education programs are carried out by faculty and graduate students at Texas A&M University. The College of Education ranked 4th in institutional productivity of research and program development efforts in teacher education between 1980-84 among institutions of higher education in the United States, according to a study conducted by Denton, Tsai, and Cloud (1986). Productivity in this inquiry was defined in terms of: (a) the number of presentations referenced to an institution at the annual conferences of the Association of Teacher Educators (ATE), the American Association of Colleges of Teacher Education (AACTE), and the Special Interest Group on Teacher Education of the American Educational Research Association (AERA-Sig-Teacher Ed); and (b) the number of publications associated with an institution occurring in the Journal of Teacher Education (JTE) and Action in Teacher Education (ACTED).

Program development certainly has not abated since 1984. Given the urgings by the dean and the impetus from national reform reports, including the Carnegie Forum on Education and the Economy report, A Nation Prepared: Teachers for the 21st Century (1986) the National Governors' Association report, Time for Results: The Governors 1991 Report on Education (1986) , and the Holmes Group report, Tomorrow's Teachers: A Report of the Holmes Group (1986), varied approaches to

teacher preparation programs are being tried across the college.

Content Maps and Instructional Model

Content maps of pedagogy illustrating program elements identified from empirical evidence, experience, and theory are presented in Appendix A. These elements (concepts) were subsequently grouped into content clusters and integrated into instructional activities. The sequencing of these activities was compatible with the diagnostic-prescriptive model of instruction (Armstrong, Denton & Savage, 1978) espoused as the instructional model for interns to implement in their classrooms. This model of instruction describes teaching as a series of processes requiring five distinct instructional skills: specifying performance objectives, diagnosing learners, selecting instructional strategies, interacting with learners, and evaluating the effectiveness of instruction.

This model provides a conceptual framework for teaching interns as they apply concepts and principles of pedagogy to practical instructional problems that arise in the classroom. Moreover, this model encourages the development of individual teaching styles. Individualized styles are encouraged because of the emphasis placed on determining the entry level skills of learners and then accounting for these skills as the instructional strategies are developed. Teachers in preparation are free to choose techniques and materials which they believe will enable learners to achieve the performance objectives. If during the implementation of instructional strategies learners do not demonstrate satisfactory progress, the teaching candidate adjusts the strategy or attempts another approach. In this model, evaluating

the instructional plan is of a formative and iterative nature.

Course Offerings

Thirty-six semester hours of course work are associated with the alternative certification program. The sequence of course work illustrated in Table 1 permits the candidate to earn a Master of Education degree while satisfying requirements for certification. The program begins in June and concludes, for those candidates remaining on-schedule, some 15 months later with summer graduation exercises.

Table 1 : Graduate Certification Course Work Sequence

FIRST SUMMER SEMESTER (10 weeks)

EDCI 406 (4 sem.hrs.) - Science in the Middle and Secondary School
or
EDCI 407 (4 sem.hrs.) - Mathematics in the Middle and Secondary School
EDCI 682 (2 sem.hr.) - Seminar in Field and Laboratory Experiences
EDCI 603 (3 sem.hrs.) - Models for Classroom Management Processes
EDCI 604 (3 sem.hrs.) - Theory and Instructional Design of Teaching

ACADEMIC YEAR
Fall
EDCI 684 (3 sem.hrs.) - Professional Internship
EDCI 673 (3 sem.hrs.) - Analysis of Teaching Behavior
Spring
EDCI 684 (3 sem.hrs.) - Professional Internship
EDCI 676 (3 sem.hrs.) - Teaching Strategies: Critical Problems

SECOND SUMMER SEMESTER (10 weeks)
EDCI 602 (3 sem.hrs.) - Cultural Foundations
EDCI 644 (3 sem.hrs.) - Curriculum Development
Electives (6 sem.hrs.)

During the initial summer experience, candidates complete course work emphasizing instructional design, classroom management, and instructional resources. Additional experiences in operating secondary classrooms are arranged for the candidates.

Course work which accompany the paid professional internship place

substantial emphasis on classroom practices. Research protocols and empirical findings on teaching and learning are stressed in these courses. The culminating experience of the internship is an instructional research project completed by the candidate during the year.

During the final summer, two courses of the required core courses in the traditional master's degree and six semester hours of electives are completed. Capping the program, a written report of the recently completed instructional investigation is prepared and defended. Non-course requirements for certification such as the ExCET examination are also completed during the final stages of the program.

Science in the Middle and Secondary School (EDCI 406): This course presents trends in science education, and practical resources for science instruction. However, the primary focus centers on the organization, management, and safety of science laboratories for instruction. Microteaching exercises and extra class science experiences such as field trips and science fairs are also experienced or examined in this course.

Mathematics in the Middle and Senior School (EDCI 407): This is a four semester hour course, one semester hour of which is set aside for microteaching experiences. The course considers a variety of techniques and materials useful in the teaching of secondary level mathematics. The content domain includes a list of mathematical topics, which has whole number algorithms at one end and assorted integration techniques at the other, and student interests/abilities ranging from enthusiastic/gifted to disenchanted/resistant among the domain elements.

Seminar in Field and Laboratory Experiences (EDCI 682): This course provides candidates with actual classroom experiences from the

perspective of a teacher. A variety of activities are completed, including observing teaching;tutoring individual learners; monitoring a test; instructing a class over a single topic; interviewing school personnel, students and parents; and providing assistance to teachers with instructional tasks. Forty-five clock hours of field experience are scheduled to permit candidates sufficient opportunity to participate in each of the listed activities.

Models for Classroom Management Processes (EDCI 603): This course presents recent research findings and models for classroom and school discipline management. The design, implementation, and evaluation of management programs are examined with respect to the changing student, schools as organizations, and expectations of the community and state.

Theory and Instructional Design of Teaching (EDCI 604): This course examines the diagnostic prescriptive model of instruction in detail, through study of the instructional skills associated with the model (Armstrong, Denton, & Savage, 1978). In addition, special emphasis is placed on scope and sequence decisions of the science or mathematics content to be taught by candidates because ensuing instructional design decisions in this instructional model depend on the characteristics of the target content. The major requirement of this course is the development of a guided instructional unit which incorporates individual instructional design skills.

Professional Internship (EDCI 684): Candidates earn 6 semester hours of academic credit (3 semester hours/semester) for their professional field experience. During this experience, candidates are responsible for teaching four classes each day throughout the academic

year. The candidates are supervised by school district supervisors as well as university personnel. Video recordings of entire class sessions are recorded on each candidate for subsequent analysis and feedback. Formal evaluations of the candidate's instructional skills are conducted by district evaluators with the Texas Teacher Appraisal Instrument.

The school assigns a mentor teacher to assist and counsel the candidate and to serve as a teaching model. Candidates in turn are expected to complete frequent classroom observations of the mentor and other colleagues. Because candidates are teachers-of-record in these assignments, they are employed by the host school district for one-half the salary of an entry-level teacher holding a baccalaureate degree.

Analysis of Teaching Behavior (EDCI 673): This course is designed as a "theory into practice" course accompanying the first semester of the candidate's professional internship. Multiple variables influencing teaching in secondary schools are stressed (i.e., teacher expectations, learner motivation, classroom management, teacher planning and decision making, mastery learning, individualized instruction, and group approaches for working with heterogeneous classes). Candidates are required to develop and field test a classroom observation scale and develop a proposal for an instructional investigation during this course.

Teaching Strategies: Critical Problems (EDCI 676): This course continues with the "theory into practice" emphasis initiated with EDCI 673. This course accompanies the second semester of the candidates'

professional internship. Classroom experiences of the candidates are examined from the perspectives of metacognition, problem solving, thinking skills strategies, modes of knowledge, deductive and inductive logic. Candidates are also required to provide a preliminary report of their completed investigation at the end of this course.

Cultural Foundations (EDCI 602): This course examines social and cultural forces which influence school systems (the whole and its parts). A sociological perspective employing a conflict analysis model is the instructional vehicle used to examine issues and problems as they relate to the individual, culture, society and the school. The culminating experience of the course is a substantive library research paper, addressing the social forces affecting an educational problem (e.g., influence of school reform on educational equity and excellence).

Curriculum Development (EDCI 644): This course contains both theoretical and application components. Initially, elements of a course and how they are developed are addressed. Once these issues have been integrated into an operational plan for constructing a course design, emphasis is directed to underlying assumptions and critical elements that influence curricular decisions in public schools. The culminating requirement is a written course design which incorporates the elements examined throughout the course.

Electives (6 Semester hours): In order for these courses to count toward the Masters of Education degree, the courses must be graduate level courses (600 series courses) and not have an EDCI prefix. A graduate program requirement states that 6 semester hours be completed

outside the department for the M.Ed. degree. Graduate course offerings in one's teaching field, educational technology (EDTC) or educational psychology (EPSY) are recommended to round out the candidate's program.

METHODS

Sample

Since this program was established as a post-baccalaureate program to certify secondary school teachers in mathematics and science, common characteristics across the candidates in cohort I and II included baccalaureate degrees with an area or emphasis in one of the sciences and/or mathematics. Cohort I (1986-87) contained 6 interns while cohort II began with 7 interns. Table 2 summarizes the academic background of the interns in both cohorts.

Table 2: Academic Characteristics of Interns

Selected for Cohorts I and II

Cohort I	degree-date	major	gender	GRE*	GPA**	teaching field (s)
Intern 1	B.S. - 86	physics	f	950	3.1	physics, mathematics
2	B.S. - 74	chemistry	m	810	2.2	science composite
3	B.S. - 73	geology	m	1120	2.5	science composite, earth science
4	B.S. - 85	chemical engineering	f	1240	3.4	physical science, chemistry
5.	B.S. - 85	chemistry	m	1160	2.4	chemistry, physical science
6.	B.A. - 57	chemical engineering	m	860	3.2	chemistry, mathematics physical science
Cohort II						
Intern 7	B.S. - 86	computer science	m	1220	2.7	mathematics, computer science
8	B.S. - 81 M.S. - 83	geology	f	1200	3.0	earth science, science composite
9	B.S. 87	geology	m	870	2.7	earth science, science composite
10	B.S. - 82	biology	m	1140	3.7	biology, science composite
11	B.S. - 85	biology	m	1020	3.2	biology, science composite
12	B.S. - 83	computer science	f	1010	3.6	mathematics, computer science
13	B.S. - 83	geology	f	1140	3.3	earth science, science composite

*GRE - Graduate Record Examination Score (Verbal + Quantitative)
**GPA - Undergraduate Grade Point Average based on 4 point scale

All interns in Cohort I satisfactorily completed requirements for certification in 1987, while interns 1-5 in Table 2 were awarded the M.Ed degree in Curriculum and Instruction. Cohort II (1987-88) contained seven interns at the outset of this program cycle in June, 1987. Unfortunately intern 13 dropped out of the program at the conclusion of the fall semester, 1987. Five of the 6 interns in Cohort II completed certification requirements in August,

1988. All six interns completed the M.Ed. degree. The sixth intern is scheduled to complete certification in October 1988. Comparing the two cohorts reveals a shift to more recent graduates and a shift in major. However, this latter shift was due to the employment needs of participating school districts.

Additional Factors which influenced the recruitment and selection of interns for these cohorts are presented in the discussion of results associated with evaluation question 5.

Evaluation Design and Data Collection

A four stage evaluation design associated with distinct curriculum development phases was used to guide the evaluation of this program. The evaluation design is illustrated in figure 1.

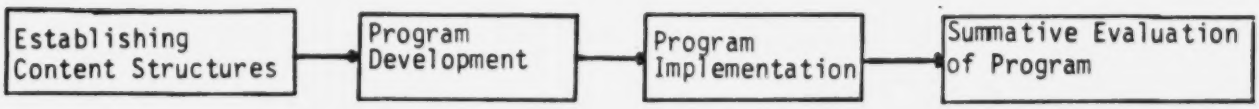

Figure 1

Four Stage Evaluation design

The initial stage of evaluation monitored the identification and sequencing of pedagogical content into content maps. Information gathered from this stage of the evaluation design provided the background for the introductory section of this paper. Stage two of this design assessed whether the pedagogical content was incorporated into the courses in an appropriate sequence and whether the instructional strategies developed to foster attainment of the concepts were effective.

Stage three of the evaluation design monitored the implementation of the program. Extensive process data were collected including video-tapes of lessons taught by interns, assessments of intern classroom practices with the Texas Teacher Appraisal System (TTAS), end-of-year interviews with interns and mentors, and administration of the instrument, Student Questionnaire about the Teacher and the Class (STQC).

Stage four, program evaluation, examined the effects of implementing the alternative certification program. Product data collected near the conclusion of each program cycle include intern performance on final examination for EDCI 676 (Teaching Strategies: Critical Problems), intern reports of instructional investigations conducted during the Professional Internship, and results from final course curriculum bound examinations administered to students of the interns and to students taught by colleagues of the interns. Analyses and interpretation of process and product data obtained during stages three and four of these analyses are reported in this paper with respect to the evaluation questions.

Instrumentation

Numerous instruments were developed or obtained to gather the requisite data for answering the first two evaluation question.

Classroom Observation System (COS): Five lessons for each intern were video taped during the course of their nine month teaching experience. These taped lessons were subsequently analyzed with the classroom observation system. This instrument was developed to record observed actions and decisions made by a teacher during a lesson regarding

classroom management, events-of-instruction, and instructional media. The theoretical framework of the instrument was based on the literature of Kounin (1970), Gagne and Briggs (1974), and research on teacher effectiveness. While the instrument could be used in a variety of settings, it was designed for large group (whole class) instruction that was directed and controlled by the teacher. Presently, the validity of the instrument is being examined by a doctoral candidate in Educational Curriculum and Instruction. A copy of the instrument and directions for its use are provided in Appendix B.

Texas Teacher Apprarsal System (TTAS: 1986): Four lessons of each intern were observed and assessed by school administrators or supervisors with the Texas Teacher Appraisal System during the professional internship. This system and its application was mandated by state law and was implemented state-wide in 1986-87.

After one year's application in assessing all classroom teachers across the state, the instrument was modified such that five performance indicators were deleted from the instrument. Thus, TTAS data obtained during 1986-87 from interns were adjusted to be compatible with TTAS intern data collected during 1987-1988. The 1987-88 version of the instrument was organized into 5 domains (Instructional Strategies, Classroom Management and Organization, Presentation of Subject Matter, Learning Environment, Professional Growth and Responsibilities). Application of the instrument required certified observers to judge whether the 65 performance indicators clustered under the 5 domains were evidenced during the teaching episode. Further, all teacher appraisers were required to attain a

stated level of coding proficiency (.70 agreement index with expert) before they were certified to use the instrument. A copy of the instrument and the conversions for making the data sets from the two versions of the TTAS compatible are provided in Appendix B.

Student Questionnaire About the Teacher and the Class (SQTC): Students of the interns were requested to complete this instrument on the teaching skills of the interns at the end of the school year. This instrument, developed by the investigator, contained 46 Likert-type items based on selected performance indicators from the TTAS. The instrument was designed to be administered with optical scan answer sheets which were used to record student responses. Cross listing of the TTAS performance indicators associated with specific items on the instrument are included in Table 3. A copy of the questionnaire is provided in Appendix B. Similar to the COS, the validity and utility of this instrument is currently being examined by a doctoral candidate. An estimate of the internal consistency (Cronbach's Alpha) of the SQTC was determined to be .96 with data collected across both cohorts.

Table 3: Performance Indicator of Texas Teacher Appraisal System that corresponds to Items on Student Questionnaire About the Teacher and the Class.

Student Questionnaire Item	TTTAS Performance Indicator	Student Questionnaire Item	TTAS Performance Indicator
1	I1 c	24	III 6c
2	I1 a	25	III 6d
3	I1 d	26	III 6e
4	I1 e	27	III 6f
5	I1 f	28	III 6g
6	I2 a	29	III 6h
7	I2 c	30	III 7a
8	I2 e	31	III 7b
9	I2 f	32	III 7c
10	II 3a	33	III 7b
11	II 3b	34	III 7d
12	II 3c	35	III 7e
13	II 3e	36	III 7f
14	II 4a	37	IV 8A
15	II 4a	38	IV 8b
16	II 4b	39	IV 8c
17	II 4c	40	IV 8d
18	II 4d	41	IV 9a
19	II 5a	42	IV 9b
20	II 5c	43	IV 9b
21	II 5d	44	IV 9c
22	II 5e	45	IV 9d
23	III 6a	46	IV 8d

2

Biology Course examination: This examination, the NABT/NSTA High School Biology Examination, was prepared by members of the high school biology examination development committee appointed by the National Association of Biology Teachers and the National Science Teachers Association. The examination contains 80 multiple choice items. The reliability (Coefficient Alpha) of the test determined from responses of biology students (taught by an intern) was .82. An item analysis of the test yielded a mean discrimination index of .25 and a mean difficulty index of .54. Items were not clustered by course objective for this particular test. This test was administered in a manner that permitted students to record their answers on optical scan sheets.

Mathematics Test: The mathematics test used in this inquiry was developed by a master's candidate in mathematics education, Rebecca Brooks. Ms. Brooks developed the test to measure subject matter competence with respect to the set of minimal objectives for Grade 11 established by the Texas Education Agency. The test, consisting of 64 multiple choice items, was developed to meet objectives to be mastered by Texas high school juniors or seniors before graduation. In other words, Rebecca's test was designed to measure the attainment of objectives associated with the Texas Educational Assessment of Minimal Skills (TEAMS). This test has been field tested and item analyzed. The estimate of internal consistency (Cronbach's Alpha) of the instrument was determined to be .87. In addition, an item analysis of the test revealed a range of item discrimination indices of .22 to .79 with 45 of the items registering indices greater than .20. Each of the following objectives was represented by either 2 or 4 test items:

Obj. 1	Select the set of numbers ordered from least to greatest (4 items)
Obj. 2	Round numbers to a particular place value (4 items)
Obj. 3.1	Translate a percent to a decimal (2 items)
Obj. 3.2	Translate a common fraction to a percent (2 items)
Obj. 4	Convert numbers from exponential notation to standard notation (4 items) (with zero appearing as the base number or exponent)
Obj. 5.1	Solve problems involving addition or subtraction of fractions and mixed numbers (4 items)
Obj 5.2	Solve problems involving multiplication or division of fractions and mixed numbers (4 items)
Obj. 6	Solve word problems involving multiple operations of whole numbers, decimals, fractions, and mixed numbers (4 items)
Obj. 7	Solve work problems involving proportions (4 items)
Obj. 8	Solve word problems involving percent (4 items)
Obj. 9	Solve problems involving metric/customary measurements using the basic operations (4 items)
Obj. 10	Solve word problems involving average (4 items)
Obj. 11	Solve word problems involving simple probability (4 items)
Obj. 12	Use information from graphs and tables to solve word problems (4 items)
Obj. 13	Solve problems involving geometric formulas (4 items)
Obj. 14	Use geometric properties to solve problems involving geometric shapes (4 items)
Obj. 15	Solve problems to determine the value of a variable (4 items)

Physical Science Test: This test was obtained from the science supervisor of the Cypress-Fairbanks School District in Houston, Texas. The test, consisting of 40 multiple choice items, was designed for the below-grade-level student in physical science. Based on the administration of the instrument to nearly 500 students, the estimate of internal consistency (Cronbach's Alpha) was determined to be .88. Moreover, an item analysis of the test yielded a mean of item discrimination index of .52 and a mean difficulty index of .58. Each of the following topics represented on the test has been cross referenced to Essential Elements (EE) of physical science listed in the state of Texas Curriculum for public schools, 19 TAC Chapter 75 Curriculum, (TEA, 1983).

E.E. 1	Laboratory safety (3 items)
E.E. 8	Laboratory apparatus (3 items)
E.E. 2	Physics concepts (13 items)
E.E. 4	Properties of matter (7 items)
E.E. 3	Chemical Concepts (9 items)
E.E. 5	Graph interpretation (5 items)

Earth Science Test: The earth science test used in the program assessment was obtained from a dissertation completed in Educational Curriculum and Instruction (Rollins, 1980). This test, developed by Dr. Mavis Rollins, contains 60 multiple choice test items. The questions were designed to measure concept attainment according to a model proposed by Frayer, Fredrick and Klausmeier (1969). Each of the five earth science concepts included in the test was analyzed for 12 components in the model. The estimate of internal consistency (Cronbach's Alpha) of this instrument was determined to be .89. Item analysis of the test produced a mean item discrimination index of .33 and a mean difficulty index of .54. Although this test was developed prior to the publication of the Essential Elements for earth science, concepts addressed on the test have been cross referenced to the state curriculum for earth science.

E.E. 2	Seasons (12 items)
E.E. 7	Environment (12 items)
E.E. 4	Changing earth (12 items)
E.E. 2B	Day and night (12 items)
E.E. 2A	Solar energy (12 items)

Data Collection Schedule

Similar schedules for collecting process and product data were implemented with both cohorts I and II. Table 4 identifies the type of data, the approximate date of data collection, and the purpose served by the data.

Table 4: Timeline for Collecting Process and Product Data

DATE	DATA TYPE	PURPOSE
June/July	Anecdotal Records	Record impressions of interns during initial field experiences in classroom
June/August	Test Performance in course work	Determine knowledge and skill acquisition associated with classroom management and instructional design
October	Video Tape of Intern's Class (#1)	Data for analysis by supervisor and intern and subsequent analysis with COS
October/November	TTAS Assessments	Fall teaching assessments by teacher appraisers of school district
October	Test Performance in course work: Analysis of Teaching Behavior	Determine whether interns were sufficiently knowledgeable about observation tools to adequately assess their video-taped class.
November	Video Tape of Intern's Class (#2)	See purpose-Tape 1
December	Final Test: Analysis of Teaching Behavior	Determine degree of skill development in analyzing teaching practices. Critique of proposed instructional research plan
January	Video Tape of Intern's Class (#3)	See purpose - Tape 1
February	Test Performance Teaching Strategies: Critical Problems	Determine intern's ability to explain learning in terms of information processing model.
March	Videotape of Intern's Class (#4)	See purpose - Tape 1
March/April	TTAS Assessments	Spring semester assessments by teacher appraisers of school district.

April/May	Videotape of Intern's Class (#5)	See purpose - Tape 1
May	Administration of Student Questionnaire About Teacher and the Class-to students of interns	Assessment of teaching skills of interns from students' perspective
May	Exit Interview for Professional Internship	Determine perceptions of interns and mentors about experiences in the program
May	Test Performance final test-Teaching Strategies: Critical Problems	Determine ability of interns to analyze teaching from different epistemological stances.
May	Administration of Content Examinations to students of interns and to students of colleagues of interns	Determine student achievement on content test linked to the curricula taught throughout the school year.
May	Submission of first draft of research report	Report conveys findings from investigation conducted during Spring semester
July	Submission of Report of Instructional Investigation	Report presented and defended to Masters degree advisory committee

RESULTS

Student Achievement (evaluation question 1)

Curriculum bound end-of-course test data were compiled from 999 students of 10 interns and 11 colleagues of interns at the conclusion of the professional internships across both cohorts. These data were gathered to determine if student achievement was affected by whether the teacher was a teaching intern or a colleague of the intern teaching the course in the same school. Unfortunately, student data from an intern (intern 5) and colleague obtained from the administration of a chemistry test were excluded from the data file because the reliability of the test was low. Further, student data were not collected for one intern (intern 6) from cohort I because his teaching experience occurred across three different classes during the course of one semester. Finally one intern (intern 10) in cohort II did not remember to administer the tests at the conclusion of the year and another intern (intern 13) dropped out of the program after one semester. The preceding explanation is offered to reconcile the participating interns identified in table 2 (interns 5, 6, 10, 13) with the interns listed with end-of-program achievement data summarized in table 5.

Table 5 Student Achievement on End-of-Year Curriculum Bound Tests Administered by Interns and Colleagues of Interns

Content	Intern				Colleague			
	Intern ID	X	S.D.	N	Colleague of Intern	X	S.D.	N
Biology	11	43.00	9.17	30		___	___	___
Earth Sci.	3	31.13	11.47	16		___	___	___
	8	24.00	6.29	9	8	23.0	7.17	11
Physical Sci	2	22.74	6.46	61	2	22.18	8.18	83
					2	21.57	6.82	76
	4	27.54	4.92	79	4	26.57	7.10	68
					4	19.82	8.57	85
	9	28.10	5.87	68	9	27.18	5.35	72
					9	27.41	6.24	94
					9	23.52	6.58	97
Mathematics	1	18.81	8.41	21	1	33.20	7.38	40
	7	22.67	6.04	29	7	25.25	6.89	40
	12	23.53	6.93	30	12	41.71	8.01	12

Comparison data were obtained by seven interns from classes of colleagues, but student tests were not administered in classes of colleagues for interns 3 and 11. Intern 3 did not request colleagues to administer the earth science test because his total experience was one semester long, and comparisons with colleagues who taught the course for the full year would have been confounded. In the second case, Intern 11 was responsible for instructing biology students in an experimental program (science academy) initiated by the school district. Students were selected from across the district to participate in the program which emphasized computer technology and biomedical science. Because of the selection procedures for participating in the program, the specialized curriculum, and the daily three hour class periods scheduled for the program comparable biology classes were not available for assessing this particular intern's teaching skills.

Examining table 5 reveals that students of interns who taught earth science and physical science scored slightly higher on the year-end curriculum bound tests than their counterparts. Using the non-parametric sign test as the technique for statistical comparison, the achievement of earth science and physical science students of interns was greater statistically ($p=.004$) than the achievement of peers taught by colleagues of the intern in the same school. However, when achievement values in mathematics were entered in the calculations, the statistical differences did not occur ($p=.113$). In fact, students in mathematics classes taught by colleagues out-performed students in classes taught by interns. The only case across the intern - colleague comparisons where the classes were likely different in ability occurred

with intern 12. In this comparison, the intern was teaching a Fundamentals of Mathematics course to ninth graders while the comparison class was an Algebra I class of ninth graders. In summary, student achievement scores on curriculum bound end-of-course tests in science courses were positively affected if the teacher was a teaching intern in the alternative certification program. However, when the results of mathematics tests were added the advantage of being in an intern's class disappeared.

Teaching Practices (evaluation question 2)

As noted in the program/component description, empirical, experiential and theoretical content elements and a particular instructional model were incorporated into the curriculum of the non-traditional teacher preparation program. In order to monitor whether the emphasized pedagogical concepts and skills were being exhibited in the interns' classes, actual classroom observations were completed by trained TTAS evaluators and numerous video-recordings of class sessions on each intern were made. The recorded lessons were subsequently analyzed with the COS. In addition, classes completed a questionnaire (SQTC) about the intern's teaching practices near the end of the school year. Data obtained from these measurement activities conducted as part of the third stage of the evaluation design have been analyzed with respect to evaluation question two.

Among these data, TTAS evaluation summaries were examined first since favorable TTAS evaluations were necessary in order for certification to be recommended by the school districts. All interns who completed a full year of teaching were evaluated on 4 different occasions. However, interns (3 and 5) who completed one semester of

teaching were not formally evaluated by school district administrators/supervisors with the TTAS. These two individuals met the field experience requirements for certification through successfully completing field experiences akin to a student teaching experience.

Table 6 presents semester summaries of the TTAS evaluations across domains I-IV of the instrument. Each tabular value represents the average score obtained from two appraisers observing on separate occasions during each semester. The criterion score represents the baseline score necessary to demonstrate a satisfactory performance for that domain. If an intern's score (performance) was less than satisfactory across any of the domains a conference was held with the intern. Seven values across the 80 values in table 6 were below the criterion value. Six of these sub-standard scores occurred in the classroom management domain, and one in the learning environment domain.

Table 6 Summary of TTAS Evaluations - Domains I-IV

Intern		Domain			
		I	II	III	IV
	*Criterion	80	14	10.0	6.0
1	Fall	12	15	15	9
	Spring	13	15.5	15.5	9
2	Fall	8.5	10.5	10.5	5.5
	Spring	13.5	17.5	15	10
4	Fall	12	14	12.5	6.5
	Spring	17	18	15.5	9
5	Fall	13	14.5	14.5	8
	Spring	14	15.5	14.5	8
7	Fall	11.5	15	14.5	7.5
	Spring	13.5	12.5	15	9.5
8	Fall	11	15	17	6
	Spring	16.5	13	15.5	9
9	Fall	13.5	16.5	15.5	12.5
	Spring	13.5	19.5	15.5	11
10	Fall	13	16.5	12	7.5
	Spring	12	15	14	9
11	Fall	10	11	13	2
	Spring	16	13	17	9
12	Fall	11.5	10	12.5	6
	Spring	12	18	15.5	8

*Satisfactory criterion level as specified by the Texas Education Agency
Domain I Instructional Strategies
Domain II Classroom Management
Domain III Class Presentations
Domain IV Learning Environment

Apparently the remediation plan developed for the individual with the low learning environments score was successful, because the spring assessment of this domain for this individual easily exceeded the criterion value. This pattern also occurred for the classroom management scores for interns 2 and 12. Intern 11 registered a higher score but the improvement was not sufficient to reach criterion in the spring.

Unfortunately, interns 7 and 8 registered lower evaluations for the classroom management domain in the spring than they had received in their fall evaluations. Both of these individual exceeded the criterion score for the fall evaluations but did not quite reach it in the spring. However, these individuals did register sufficient improvement across the other three domains to attain higher overall scores from their spring evaluations compared to the fall evaluations.

Collectively, the domain evaluations improved across the year for the interns in both cohorts. Twenty-nine of the spring domain values in table 6 exceeded the corresponding fall values, while 6 values from the spring assessments were lower than the interns' fall scores and 5 sets of scores remained unchanged. The domain score comparisons (fall-spring) ranged from -2.5 to 8 while the total score comparisons across the interns ranged from 1 to 21.5. In the total score comparisons, all interns received their highest evaluations from the spring assessments.

In addition to the TTAS assessments, questionnaires (SQTC) were administered to students of the interns near the conclusion of the school year.

Favorable TTAS assessments noted previously suggest interns did

implement recommended pedagogical concepts and skills into their teaching practices. Moreover, these pedagogical skills and knowledge are directly associated with the curricular elements in the non-traditional certification program. Perceptions from class observers (students) participating in class experiences throughout the school year provide additional evidence of the teaching intern's proficiency in the classroom. Table 7 presents an averaged domain score across interns' spring TTAS assessments, an averaged score of student perceptions clustered into the four TTAS domains, and courses in the curriculum which address these domains. Two criterion scores were noted for each TTAS domain, that is, satisfactory and exceeds expectations scores, clearly the TTAS domain averages exceeded the criterion scores for "satisfactory" levels of performance across all four domains. Three of the domain averages, i.e., instructional strategies, class presentations and learning environment exceeded the criterion scores for "exceeds expectations".

Table 7 Summary of Spring TTAS Assessments and SQTC Responses Related to Courses in Certification Program

TTAS domain	TTAS criterion*	TTAS Averaged Score	SQTC criterion**	SQTC Averaged Score	Course Number(s) (EDCI)
Instructional Strategies	8/13	13.3	31.5	34.7	406/407 604 673
II Classroom Management	4/17	14.7	45.5	49.4	603 673
III Class Presentations	10/13	14.5	49	54.2	406/407 604 673 676
IV Learning Environment	6/8	8.6	35	38.2	603 604 673

*Criterion Scores of TTAS
First Score = Satisfactory criterion level as specified by the Texas Education Agency
Second Score = Exceeds expectations criterion level as specified by the Texas Education Agency

**Criterion Scores of SQTC
Assumes an average response of 3.5 on 5 point scale for each item

Averaged domain scores of student perceptions exceeded the criterion levels established for each domain. The criterion level, while arbitrarily chosen to be 3.5, was established to represent a baseline value on the positive end of the rating scale. Certainly no claim is made that 3.5 is a more defensible criterion point than 3.3, 3.9, or any other value on the positive end of the scale, yet it approximates the "satisfactory" criterion established by TEA for the TTAS domain assessments. Apparently the students perceived the interns to be "satisfactory" in discharging their duties as teachers during their internship. However, correlation values between domain assessments from the TTAS and SQTC were determined to be low to modest, i.e., instructional strategies, r=-.36, p:.15; classroom management r=.33, p:.18; class presentations, r=.29, p:.21; learning environment r=-.12, p:.39. The modest correlations between student perceptions and teacher appraisal ratings across the TTAS domains may be attributed to the different perspectives of student and administrators and the understanding each group had of the behavioral indicators being assessed across both instruments. Collectively, the curricular delivery system, (i.e., the courses listed in Table 7), appears to have developed sufficient background and attitudinal set for interns to exhibit sufficient skills in their classrooms to receive "satisfactory" ratings from both their students and teacher appraisers from the school district.

Observing the video-taped lessons for interns through the application of the Classroom Observation System (COS) has provided more specific information regarding the extent interns incorporated desired pedagogical knowledge and skills into their teaching behaviors.

For example, Kounin (1970) identified particular classroom management functions, including withitness, overlapping, transitions, smoothness and momentum, group alerting, and accountability which occur in well-managed classrooms. These functions were incorporated in observation categories of the COS. Table 8 provides a summary of the management functions observed across five lessons during the school year for cohort I. Similar analyses for cohort II interns are in-progress. Typically, each lesson was taped in its entirety resulting in 50 minute class episodes, although recorded lessons for the fifth observation were less than 50 minutes in duration. The category, withitness, coded when the intern disciplined deviating students and acted promptly to redirect students to class tasks was observed most frequently across lessons. The categories, overlapping (dealing with multiple issues at the same time), transitions (shifting smoothly to different activities), momentum (maintaining appropriate lesson pace), and alerting (keeping the entire class attentive) were noted as infrequent occurrences across the lessons. The only category not observed was accountability which was to be coded when the students were required to perform or demonstrate a skill after being forewarned they would be held to report. Typically accountability occurs in conjunction with alerting students to an upcoming performance or demonstrations. The final category, Not Appropriate was recorded when an intern failed to exhibit one of the management functions when the situation called for it or applied a function in an inappropriate manner. While Not Appropriate management functions were noted across the lessons, the frequency of such instances was modest, and may be linked with the absence of accountability occurrences across the lessons.

Table 8 Average Frequency of Kounin's Classroom Management Functions Observed Across Five Lessons Taught by Interns in Cohort I

Function	Observation 1	2	3	4	5
Withitness	43	46	39	49	29
Overlapping	1	1	1	1	1
Transitions	1	1	1	2	1
Momentum	1	1	8	0	0
Alerting	3	2	2	3	1
Accountability	0	0	0	0	0
Not Appropriate	3	4	0	3	3

The COS also included an observational domain associated with instructional processes occurring during a class. This classification system is based on the events of instruction identified by Gagne and Briggs (1974). Table 9 provides a summary of the instructional processes occurring across the video-taped lessons of interns in cohort I. As noted previously, similar analyses are underway for interns in cohort II. Multiple instructional events often occurred across the one-minute observation periods, thus the total frequency of instructional events observed across lessons exceeded the number of minutes of observation, i.e, 50. The instructional events most frequently observed were learner guidance (providing cues and organizers to learners), eliciting learner performance (requesting learner to respond or demonstrate an intellectual skill), and feedback (teacher's response to a learner's performance). The relative high frequency of these instructional events suggest the interns were consistent in their behaviors of guiding learners and requesting the demonstration of the skill under consideration. Further, information on the appropriateness of the learner's response usually followed the response.

Table 9 Average frequency of Events-of-Instruction Observed Across Five Lessons Taught by Interns in Cohort I

Event of Instruction	Observation 1	2	3	4	5
Gaining Attention	2	2	1	3	1
Objective Provided	2	2	3	3	1
Prerequisites Reviewed	1	4	1	3	1
Presentation of New Information	15	17	5	4	5
Learner Guidance	21	21	32	32	13
Eliciting Learner Performance	27	15	19	23	22
Feedback	14	26	29	20	10
Retention Transfer	0	1	0	2	0
Non-Event	8	8	6	11	7

Other instructional events, such as, gaining attention (alerting students to the task), objective provided (providing students with objective of lesson), prerequisites reviewed (efforts to relate prior learning to a current topic), and presentation of new information (presenting new information to be learned) while evident across each lesson did not occur for extensive periods of time during the lessons. This pattern of instructional events suggests the interns encouraged students to be actively involved in the class rather than passively receiving information. However, the non-event category was recorded when the events taking place were managerial rather than instructional in nature. The relative frequency of non-events was sufficiently high across the lessons to consider strategies for reducing class-time on non-instructional aspects. Collectively, the occurrence of the various events-of-instruction across observations suggest the interns of cohort I integrated the tenets of instructional psychology espoused in the program's course work into their teaching repertoires.

The final domain of the COS, media support, enabled information to be gathered on the type of media being used by interns during class. This information is summarized in Table 10. Media resource applications most frequently observed involved the chalkboard and transparency projector. However, occasional lessons were observed which incorporated charts, textual material, microcomputer activities, and models. It is evident the interns in cohort I did not employ a wide variety of media resources across the recorded lessons, relying instead on the conventional chalkboard and overhead projector to record printed messages for students. Certainly one recommendation for future program cycles is to encourage interns to incorporate a greater

variety of instructional resources in their class activities.

Table 10 Average Frequency of Media Applications Observed Across Five Lessons Taught by Interns in Cohort I

	Observations				
Media	1	2	3	4	5
Chalkboard	18	16	14	12	8
Transparencies	8	14	13	15	0
Slides	0	0	0	0	0
Film	0	0	0	0	0
Video Tape	0	0	0	0	0
Audio Tape	0	0	0	0	0
Microcomputer	0	0	0	0	8
Chart	0	6	0	1	0
Text	0	6	1	1	0
Model	1	0	0	0	1
Other	7	1	4	3	0
Not Applying Media	13	7	15	22	14

Reflective Thinking about Teaching (evaluation question 3)

A substantial portion of the course work which accompanied the internship for cohorts I and II sought to foster reflective thinking especially in terms of classroom events. The following general pattern was observed across both cohorts. Discussions throughout the fall semester centered on past events during class, but the level of thinking rarely moved beyond reporting what had occurred and observations about how to handle a situation should it reoccur. Efforts to link these events with organizational theory, school

context, teacher effectiveness literature and teacher decision-making literature were only moderately successful, because it appeared the interns were so involved with their instructional responsibilities and learning the operational roles of a teacher they had precious little time to be reflective about behaviors of teachers. Only when the interns viewed video tape episodes of their own teaching and were challenged to explain what they were doing in terms of the instructional and management principles encountered during summer school was there any discussion which could be described as "reflective".

In the course accompanying the second semester of the professional internship, the focus changed. Multiple topics including metacognition, problem solving and epistemology provided perspectives for examining classroom experiences. The interns from both cohorts enjoyed the problem-solving activities but did not attempt to implement these strategies into their instructional plans. As the course moved into the study of different epistemologies the interns were finally ready or forced to be ready to reflect on the nature of the knowledge they were teaching and how it should be organized to facilitate learning in their classes. This shift in thinking occurred in April, eight months into the professional internship. Again, due to their classroom responsibilities, the interns were often ill-prepared for class sessions. Given this
context, quality responses were not anticipated on the mid-term examination, yet interns from both cohorts demonstrated insight and attention to the literature in their responses. The following examples are provided to illustrate their progress in interpreting course

material in terms of their teaching experiences.

OBJECTIVES (Listed in Course Syllabus - Spring, 1987)

4. Discuss the strengths and limitations of intuition on scientific thought and knowledge production. This objective will be attained by satisfactorily responding to an essay item on a progress test. Response appropriateness will be based on adequacy of content and clarity of written expression.

5. Compare tenets of modes of knowledge, e.g. interpersonal, narrative, paradigmatic, formal, and practical. This objective will be achieved by satisfactorily responding to an essay item on a progress test. Response appropriateness will be based on adequacy and thoroughness of content coverage and clarity of written expression.

TEST ITEMS

Objective 4 (essay)

In what sense is the knowledge embodied in the sciences rationally justified? Answer this question after considering two related concepts (logical positivism and relativism). In addition, provide your own judgement of your epistemology as it relates to this question (expected length 6-8 pages).

Objective 5 (essay)

While practical knowledge (Sternberg and Corusco) and interpersonal knowledge (Berscheld) are not emphasized in the elementary and secondary curricula, justification for their inclusion is made in the text. Your task in this question is to do what the objective denotes. Compare the characteristics of these two types of knowledge, then suggest whether it is feasible to make room in the present curriculum for practical and interpersonal knowledge (expected length 6-8 pages).

The first response to the essay item (Objective 4) is the response of an intern teaching earth science who encountered a fundamentalist student in class.

For me the wide margin that separates some views of scientific knowledge was brought sharply into focus this week. Kuhn in his book, The Structure of Scientific Revolutions, states that scientists (or any people) with

completely rival paradigms will not be able to engage in any type of rational dialogue concerning their concepts. The reason being that each person has a completely different set of rules, problems and concepts concerning the issue.

I experienced this problem while introducing an Earth Science unit concerning geologic time while describing the dominate species that lived during each geologic period, I was asked why man wasn't considered the dominant species during the Cambrian period. I answered that man wouldn't even make his appearance for another 597 million years -- the discussion was on. The students began asking all the common questions concerning the evolution of man which I answered as tactfully as possible (knowing full well how the subject could deteriorate). The questioning had just about finished when one student asked if I really believed in primitive man. I answered most certainly (the students were discussing the appearance of "cave men"). She then flatly stated that she didn't, that man had never changed and will not in the future. I answered by stating that all things change with time, which is probably one of the cornerstones of Earth Science and Geology. I continued my lesson and was asked another question by the same student "whether or not ancient man could speak?" to which I answered no. She then stated that I was completely wrong because God had spoken to Adam and Eve. At this point I dropped the subject of man and began discussing the rise of Trilobites. The preceding (discussion) had so upset the student that she began to cry. She later went to the counselor's office to complain that "Evolution" was being taught and it offend her beliefs. To my surprise, as word spread about the event, several teachers came to the defense of the student. I was totally surprised by the narrow mindedness of their arguments and complete refusal to discuss the subject. They were 100 percent sure of their position and wouldn't entertain any thoughts to the contrary.

I was experiencing what Kuhn had described in The Structure of Scientific Revolution. The two separate concepts and beliefs had mixed like oil and water -- there was no middle ground.

This event made me take a long hard look at my beliefs concerning scientific knowledge. I have always considered myself to be very open-minded and willing to accept any new concept or idea if a convincing argument is made. The discussion of logical positivism and relativism made me realize that there indeed are many points of view on all subjects, any of which could be considered correct considering a person's point of view.

As a science teacher I believe that one of my most

> important tasks is to try to get my students to be open to all new ideas and concepts, especially those that seem to go against their perceptions of knowledge. Once students are willing to entertain new concepts and ideas the instructor can move more into the basis for that knowledge.

The next segment is the concluding paragraph to the essay item associated with Objective 4 from an intern teaching chemistry.

> There is a happy medium to which teachers can try to strive to incorporate both logical positivism and relativism in the classroom. Ideally, a teacher could structure the class so that the basic knowledge upon which to build can be taught. Once this basic knowledge has been seeded in the mind of the learner, this learner can experience the concept himself in the laboratory. The laboratory is less structured than the classroom in that a student can make mistakes without the fear of a penalty from the teacher. Once the learner has had a chance to experience the concept, then he can come up with his own theories and explanations. With a little prompting and channeling from the teacher, a student can formulate the standard theories. The learner can then rightfully call the derived theory his own and can move up the ladder to even more challenging and complex ideas. To be realistic, this situation is idealistic at best due to many factors such as size of the classroom, laboratory facilities, equipment, and so on. Knowledge conceived is not in the sciences, but in oneself. Independent of whether the knowledge is gained through experience or transmitted form someone else, as long as it is embodied in someone and practiced, knowledge will never cease to exist.

These responses reflect different styles of expression, but remarkable consistency regarding their collective view of the nature of knowledge (relative positivism) and its influence on their teaching of science.

Responses to the essay item associated with Objective 5 follow:

The following response is from an intern who taught physical science.

> Without a facility for applying interpersonal knowledge and practical knowledge, one cannot expect to function effectively in today's society. People are not learning how to use these types of knowledge in the public school system and as a result are not learning in school what they need to know to be happy, productive individuals. In the long run,

> our educational system would better serve society by making practical knowledge and interpersonal knowledge a more viable part of the curriculum.
>
> The next response is from an intern who taught chemistry.
>
> Unfortunately for the school system, practical knowledge is not deemed as important in the curriculum as academic knowledge. If a student wishes to obtain practical knowledge, then vocational programsare offered at most schools. For the college-bound student, however, one of the few electives available would have to be used. Otherwise, practical knowledge must to be acquired outside the school environment. Until there is a shift away from the basics and academic learning, it would be difficult to incorporate the teaching of practical knowledge in secondary schools.
>
> Interpersonal knowledge, however, is easier to incorporate into the schools. Extra-curricular activities such as sports, band, choir, and so on, teach individuals to rely on others for the success of a program. The problem does not rest in the availability of these programs. On the contrary, many such programs are offered to the students. The problem is that those students in the extra-curricular programs already have the ability to get along with others. How does one get the students who need the activities to join? A&M Consolidated High School has a partial answer to this question. During the freshman year of high school, a humanities course such as band, choir or orchestra, is required to be taken as a class. This method involves all of the freshmen students and tries to establish rapport among the students at an early age. The earlier that a student involves himself in this sort of activity, the easier the attainment of interpersonal knowledge.

In these responses, the interns reveal some appreciation for the value of practical and interpersonal knowledge and note the limitations of schools in meeting the goals of curricula based on these tenets.

Another set of written documents was obtained from interns at the conclusion of the program. As noted previously, interns were responsible for conducting an investigation during the internship. Their final examination for the master's degree was a presentation of research findings from this investigation presented in oral and written form. Abstracts of 11 papers are presented (one intern elected to forego the degree and did not complete the paper). These abstracts

illustrate to some extent, reflective thoughts the interns expressed at the conclusion of their programs.

ABILITY GROUPING: WHO BENEFITS?
Intern 03

This study was conducted to examine the tenets of ability grouping and related teacher expectations pertaining to 7th grade life science students. The study was conducted in a junior high school located in a community near Houston during the spring semester of the 1986-87 school year. It was hypothesized that ALL subjects in the study (n=33) had the ability to master the requirements of the 7th grade life science curriculum as established by the essential elements of the state mandated curriculum. Academic records of 33 subjects were examined in the study. Stratified random samples of 11 subjects from three ability levels (gifted, on-level, basic) were selected. Instructional strategies for the gifted and on-level ability students were not altered. For both groups of subjects an active attempt was made to encourage student participation, emphasize instructional objectives, relate the content to the subjects' lives, and relate new knowledge to previously learned information. While essentially the same instructional moves were applied to the basic subjects, considerably more drill and practice activities were completed by these subjects.

In all three groups subjects met or surpassed the hypothesized expectations of the study. The results of this study support the literature on teacher expectancy and its powerful influence on student achievement, that is, when teachers have high expectations for their students and convey these expectations to them, the students will generally strive to fulfill the desired expectancies.

THE EFFECTS OF PEER TEACHING ON STUDENT ACHIEVEMENT
Intern 01

In this study, the hypothesis that the act of teaching a concept to others results in better short-term understanding and long-term retention was investigated. Fourteen secondary math students, most identified as low achievers, served in turn as peer teachers. Each student became "teacher for the day" and was responsible for the lecture, administering and grading a self-made quiz, and monitoring seatwork. It was believed that the exposure, rehearsal, and responsibility for the learning of others would contribute to the meaningfulness and integration of content. Each student was tested, within two weeks of their teaching presentation, for short-term retention, and again, after several months, for long-term retention. Analysis of these data revealed a significant positive link between peer teaching and retention. Further, a correlation coefficient (r=.95) indicated an almost linear

relationship between student performance on the tests for short-term retention and tests for long-term retention.

EVALUATION OF THE EFFECT OF A STUDY SKILL WORKSHOP ON STUDENT GRADES
Intern - 04

In an effect to improve student grades and attitudes, many schools provide workshops for students on study skills. This study examined the study skills workshops offered by a high school in the Houston area to 39 students. Workshop participants' six-week grades for the grading period prior to the workshops were compared with six-week grades during the workshop and with the six week grades following the workshops. Statistical analyses of the three sets of grades revealed no statistically significant improvement in the grades of the participants due to participating in the workshops.

COOPERATIVE LEARNING; AN ALTERNATIVE TO TRADITIONAL CLASSROOM INSTRUCTION
Intern 05

Empirical evidence suggests that students who work in cooperative learning groups attain higher levels of achievement and enjoy the subject more than they would under conventional individually oriented instructional experiences. The goal of this research was to raise high school chemistry students' grade averages and attitudes about the class through cooperative learning strategies. Subjects were 85 students enrolled in general chemistry in a suburban high school in the Houston area. The study encompassed the regular 36 weeks of an academic year. During the first 18 weeks, students received regular teacher directed large group instruction which fostered competition among students especially regarding course grades. Beginning with the second semester, students were divided into groups of 4-6 students and encouraged to work together in review and application activities while receiving formal presentations in large group settings and being responsible as individuals for laboratory work, quizzes, and examinations. Results of this investigation indicate cooperative strategies produced equivalent grades across semesters and improved attitudes toward chemistry. The cooperative learning strategy was particularly beneficial for some students who experienced a poor start in chemistry during the fall semester.

CRITERION-REFERENCED OR NORM-REFERENCED GRADING?
Intern 02

A criterion-referenced grading system determines grades based on where a performance reach on an absolute scale. This study was conducted to determine the relative

merits of criterion referenced and norm referenced grading systems. Four sets of examination results were obtained and analyzed with respect to the two methods for assigning grades. All data were from ninth grade physical science classes. With the criterion referenced grading method, the minimum level of performance necessary for attaining the objective was set at 70 percent. Each examination contained test items that addressed at least 4 objectives with from 2 to 20 items being provided per objective. For the norm referenced method, the total test score was determined and grades were awarded based on the position of the individual student's score with respect to the grand mean on the test.

Results of the analysis revealed a greater number of passing grades when the norm referenced grading was applied to the test data. Conversely, when the criterion referenced system was applied the frequency of A's (17 compared to 6) and F's (34 compared to 5) were substantially greater than when the norm referenced system was applied to the test data.

THE EFFECTS OF IMMEDIATE FEED BACK ON HIGH SCHOOL GEOMETRY STUDENTS
Intern 07

The research question for this investigation was: Does the method of assessing application exercises of secondary mathematics students affect achievement of mathematical skills and knowledge? Students participating in this investigation were members of two on-level geometry classes. The dependent variable was determined by administering curriculum bound unit tests with items linked to the unit objectives. The teaching strategy was identical for each class in the various units, except for the method of feedback provided on daily work. The control group was given homework on a daily basis. The homework was evaluated on a completion basis, that is, the teacher surveyed the class during seat work to see that each problem was attempted. If the problem was attempted, the student received "credit" for her/his homework. The experimental group was also given daily homework exercises which were also assessed on the basis of completion. However, the experimental group was also administered a daily quiz which was based on the homework exercises. The statistical analysis yielded significant differences at the .10 level of significance ($t=1.63$, $df:252$) favoring the experimental treatment. That is, the class who was quizzed daily performed better on the subsequent unit tests than the class who was checked regarding whether they attempted their homework.

USE OF COOPERATIVE LEARNING IN THE SECONDARY SCHOOL CLASSROOM
Intern 08

This inquiry examined whether cooperative learning strategies increases student success, not only success as a means of greater academic attainment, but also success as a person, with improved attitudes toward school and science as well as more tolerance toward peers.

Three seventh grade Life Science classes and one eight grade Earth Science class participated in this inquiry. The study encompassed 18 weeks, with 2 classes receiving regular large group instruction for 6 weeks and the other 2 classes receiving a cooperative learning strategy for 6 weeks. At the close of the 6 week grading period the cooperative classes became conventional large group classes and the other 2 classes became cooperative learning groups. Cooperative group membership was determined on the basis of prior academic attainment in class. Students in the cooperative groups were instructed they would receive a group grade. They would be graded on working together, on the final product, and on the presentation of their group project.

Results of the inquiry with respect to academic achievement were mixed, although there was a discernible trend toward improvement for the lower level students. Also, the investigator related that it was very difficult to let the classes assume responsibility for their own learning during class. Perhaps the most significant change occurred with the interpersonal growth of students in the cooperative groups.

THE EFFECTS OF COOPERATIVE LEARNING IN A CLASSROOM THAT EXHIBITED POOR ACADEMIC AND BEHAVIORAL SKILLS
Intern 09

This investigation was structured to determine the effects of cooperative learning in a classroom where poor academic and behavior skills were being exhibited by students. Three ninth grade physical science classes were involved in this investigation. The intervention used in this investigation was a modified "jigsaw" type of cooperative learning strategy. Students were assigned to small 3 to 4 member groups. Each group consisted of an assigned captain and other members who had experienced academic difficulty in physical science. Each group member was asked to research certain objectives in order to eventually teach objective referenced content to the other group members. A weekly schedule of classroom activities was printed on the chalkboard so each group member knew when they were to teach their lesson to the other group members. A criterion-referenced test containing 50 multiple choice items was administered at the conclusion of the unit to determine

accomplishment of the unit objectives.

In this investigation, the 3rd and 5th period classes served as control groups and were taught in a teacher directed large group format. The 6th period (last period) class was the experimental class in this investigation. The results of this investigation were as follows: group learning was enjoyable, it generated ideas, it developed sensitivity among group members toward others, it widened friendship groups, and helped students become more articulate, but academically, the results were mixed with some students accomplishing more while others seemed to suffer in the cooperative format.

THE EFFECTS OF GROUP COMPOSITION AND SOCIAL INCLINATION ON STUDENT ACHIEVEMENT
Intern 11

The issue under consideration in this study was whether group composition based on social inclination affects student achievement. The sample for this inquiry was a biomedical science class composed of 31 ninth grade students.

The independent variables of this inquiry consisted of student social inclination and the organization of social types into homogeneous or heterogeneous groups. The social type was determined through the administration of the Kiersey Temperment Sorter. This instrument was used to sort students into introverted/extraverted categories. Baseline data were collected before the treatment period began to serve as comparison data for determining the influence of cooperative learning strategies on subsequent test performance. A total of three units were used in the treatment phase of this inquiry. Objective tests were administered at the conclusion of each unit.

Conclusions of the inquiry based on the analysis of data collected during the treatment phase support the use of homogeneous grouping for extraverts in cooperative learning programs but not for introverts. Although extraverts seem to do very well in homogeneous groups, the effect of homogeneity on less socially inclined individuals appears detrimental to the academic progress.

MODIFYING THE SEQUENCE OF CLASS ACTIVITIES IN AN EFFORT TO ENHANCE TEST PERFORMANCE
Intern 10

This study was conducted to determine whether the sequencing of class activities during the last period class (6th period) would increase performance of junior high school earth science students. This class exhibited substantial restlessness and an unwillingness to attend to class

issue was discussed at length before the investigations were conducted; yet constraints of time and the lack of validated curriculum-linked achievement measures influenced decisions to use either teacher made tests or grades as the dependent variable. Second, the abstract issue of internal validity for their proposed research was a secondary concern; the primary concern was whether their particular intervention would influence student learning. Certainly the methodological shortcomings of these investigations have raised questions regarding the value of the findings, but from a different point of view these efforts became worthwhile when the interns' realized that investigating the instructional processes were genuine intellectual challenges that required much thought.

Collaboration between Schools and University (evaluation question 4)

While the College of Education is the governing unit responsible for teacher education from the view of the university, an advisory panel consisting of representatives from eight school districts and college faculty was established to provide advice and counsel on the development of the certification program. Five curriculum directors, two secondary principals, a secondary teacher and a director of personnel represented the public schools on the advisory group. All college faculty were members of a curriculum and instruction department. The following sections discuss program elements shaped through collaborative efforts.

Paid internship. The advisory panel provided substantial counsel to the program, including the recommendation that paid internships be incorporated into the program. This recommendation occurring early in the development of the program effectively shifted sole ownership of

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the program by the university to joint ownership between participating school districts and the university. No doubt the paid internship has influenced individuals over the past two years to become candidates for the program. Yet one of the candidates who received and later turned down a graduate fellowship indicated the paid internship came at a time when she was unemployed and the internship seemed like a desirable option to gain employment rather than a means of fulfilling a goal to become a secondary teacher. It is possible a number of other individuals have held similar motives as they applied to the program. Whether this motive was apparent to the personnel officers of the participating school districts when the candidates were interviewed is not known, but the possibility of individuals pursuing teacher certification simply as a means of gaining temporary (1 year) employment has been an unexpected consequence.

Staff development programs. A second recommendation by the panel which altered the program's direction was the requirement that only school districts with well established staff development programs be invited to participate. This recommendation was made to ensure that support and assistance be provided by the school district to the intern. The positive consequence of this recommendation has been the valued support and assistance provided to interns through orientation sessions for new faculty and mentor teachers assigned to help the new teacher in getting organized for teaching. Since these induction practices have been standard procedures in these particular schools, no special program had to be developed to ease or "orient" the intern into the district.

Unfortunately there is a downside to the staff development

requirement for participating in the program. Negative consequences have occurred because small rural school districts with critical needs for science and mathematics teachers have not been eligible to participate due to the lack of resources to provide continuing staff development programs. Paradoxically, we have created a program to prepare mathematics and science teachers yet have excluded districts with acute needs for mathematics and science teachers from participating in the program.

Formal agreements. A third recommendation of the panel was for district officials, preferably the building principal, to approve at the beginning of each year the collection of classroom observation data and cognitive measures needed for program evaluation.

Observation data included video-taped lessons recorded on each intern throughout the school year, while end-of-year measures included curriculum bound cognitive tests administered to learners of the intern and learner perceptions of the intern's instructional skills. Unexpected but highly valued class sets of data were obtained when colleagues of the interns also administered the final course examinations to their classes and provided the data to the university supervisor.

The university supervisor established rapport with the interns and their mentor teachers through frequent and substantive interactions during the early part of the school year. The supervisor visited the interns weekly spending the entire day at the school observing, critiquing and visiting with the interns and fellow faculty members. During late spring fewer visits occurred to each intern because interns settled into effective teaching routines. Clearly, the key to success

of the interns and the support of the participating schools was the close association of the university supervisor with the interns. It is clear the reason colleagues of the interns agreed to administer the final course examinations to their learners and provide the resulting data to the university was the level of trust which developed in the schools during the year.

Gaining access to these data represented a significant departure from previous district policies which restricted the collection of classroom data by university faculty for research and evaluation purposes. From a research perspective, permission to obtain class data is a major accomplishment. Collaboration in this case has opened classrooms for the prospect of knowledge production about teaching and the preparation of teachers.

Alternative certification plan. During 1986-87, districts participating in this program and the university developed an alternative certification proposal for individuals with degrees. This proposal was submitted to the Texas Education Agency and was approved for one year. As a result, interns participating in the program during 1987-88 were certified under the new certification requirements. However, in this plan candidates were certified only if both the participating school district and the university recommended the individual for certification. Given the different governance structure for alternative certification, the state closely monitored these programs and conducted an on-site evaluation of each intern in March, 1988. The evaluation team was satisfied the program was being conducted as proposed and approved the certification plan for an additional two years.

Thus, over the course of three years the role of school districts has evolved from providing advice about the preparation of teachers to providing financial resources (paid internships and mentor teachers) and becoming equal legal partners with the university in certifying secondary mathematics and science teachers in an alternative certification program. These major changes, while facilitated by changes in state regulations, came about because of the commitment and effort of individuals in these institutions.

Recruitment and Selection of Interns (evaluation question 5)

This section describes the procedures used to attract applicants to the program, processes for screening the applicants and decision processes for selecting and placing candidates in classrooms.

Developing an Applicant Pool: When recruitment efforts for cohort I were made during spring 1986, the economic plight of the oil industry in Texas was such that a large talent pool was available. Displaced engineers, geologists, and chemists were anxious to apply their academic and professional experience in secondary classrooms. Newspaper advertisements, placed in two papers May 10 and 11, 1986, generated 54 applicants within a week!

The response to these advertisements exceeded expectations, yielding far more applicants than anticipated placements. This level of interest in the program combined with the excellent academic credentials of a number of applicants indicated a valuable human resource was available at that time to help alleviate the shortage of mathematics and science teachers. While the depressed economy undoubtedly contributed to the abundance of applicants, eroding tax bases and declining school enrollments dictated retrenchment rather

than expansion by school districts.

Recruitment of candidates for cohort II began with the placement of advertisements in 4 newspapers in November, 1986. Individuals responding to these ads were mailed brochures which described the program (and unsuccessful applicants of cohort I.)

Although 107 brochures were mailed, not quite half of the individuals (48) receiving brochures requested application forms for the program. Subsequently, 21 completed applications were submitted. The attrition of individuals requesting but not submitting application forms perhaps was linked to the costs associated with the entrance examinations (i.e., GRE- $29, PPST - $40) and the number of steps involved in submitting a complete set of application materials. Thus, 21 individuals represented the applicant pool for cohort II.

Nearly the same procedures were repeated to recruit candidates for cohort III. An advertisement was placed in a single newspaper in early December, 1987; however in this instance individuals not selected for cohort II were not sent brochures. While over 70 brochures were mailed to prospective teaching candidates for cohort III, 16 completed applications were received.

Screening of Applicants: When the program began in 1986, applications were received just prior (2-3 weeks) to the beginning of the course work. Application materials were screened with respect to whether sufficient credit hours had been completed in teaching fields to qualify for the program and evidence of a baccalaureate degree. Application materials of individuals meeting these criteria were submitted to the participating school districts to use in selecting the interns.

As year two approached, a three step procedure was established to screen applicants. Individuals requesting application materials were sent a registration packet which delineated the procedures for applying and listed the requirements for admission into the program. Upon receipt of the completed applications, a review was made to determine whether the prerequisite tests had been successfully completed (GRE, PPST), whether sufficient hours had been completed in a teaching field to qualify for a teaching certificate and whether a sufficient grade point ratio (cumulative GPR=2.5) had been attained to participate in the program. Assuming these conditions were met, the final step in this process was an interview with the candidate. As part of the interview, candidates made a brief presentation (8-10 minutes) and completed the Strong-Campbell Vocational Preference Inventory. Assuming a successful presentation, biographic information and academic credentials of the candidates were compiled and shared with school districts. These procedures were used for cohorts II and III.

Placement of Candidates: Three school districts agreed to participate in the pilot phase (Cohort I) of the program. An initial group of nine individuals began the program in June, 1986. Four of these individuals had commitments from school districts when the program began. It was anticipated that the remaining individuals would be placed in paid internship positions before the beginning of the 1986 fall semester (September, 1986); unfortunately this optimistic expectation did not occur. Of the five intern candidates who began the program in June, 1986 but were not committed to a school district, one person resigned from the program midway through summer school. A second individual chose to take a part-time teaching job requiring two

years of experience in order to complete certification requirements. A third individual enrolled in course work during the fall semester (1986) and completed student teaching to fulfill certification requirements. Two other candidates participated in the course offered in conjunction with the internship during the fall semester and were placed in internships during the academic year.

At the outset of the program for cohort II, seven individuals were enrolled in course work associated with the program. Although on the first day of class (June 8, 1987), only one individual held a commitment from a district for an internship. Within six weeks, the remaining interns were placed in four school districts (3 districts from Cohort I and 1 new district).

At the beginning of the third year (Cohort III) five districts had selected 11 candidates before the first day of class (June 6, 1988). Districts who hired interns for cohort II agreed to participate again as well as one additional district. No additional placements were made after June 6, because the remaining candidates had elected not to participate in the program.

DISCUSSION

The challenge of developing a non-traditional certification program for secondary teachers which integrates pedagogical content from empirical, experiential and theoretical perspectives, resulted in an intensive 15 month program for post-baccalaureate teaching candidates. Data analyses and subsequent interpretation of these analyses suggest the efforts to integrate different epistemologies of extant content of pedagogy into an effective teacher preparation program were successful.

Drawing on the precedent of the process-product research paradigm (Good, 1979; Brophy, 1983) and past evaluation efforts of teacher education programs (Denton & Norris, 1980; Denton & Tooke, 1981-82), the criterion of student achievement was used to assess the effectiveness of the program. Student achievement in this case was determined by student performance on curriculum bound test administered at the conclusion of the school year. In order to establish a reference for comparison, experienced colleagues of interns teaching in the same department were asked to administer the curriculum-bound test to their students. This process resulted in student data being collected from 21 teachers (10 interns, 11 colleagues).

Since the unit of analysis for these comparisons was the teacher and because 4 different cognitive measures were used to obtain these data, comparison of interns and colleagues whose students had experienced a common test reduced the number of teachers with common data to 10 (3 interns, 7 colleagues). Because the number of data points was so limited, a decision was made to use the non-parametric sign test, and simply record whether students of the intern or students

of the intern's colleague attained the larger mean score. This simple procedure permitted the data from 18 teachers to be included in the analysis. Clearly this technique lacked statistical power, but it did reveal a difference in student performance across science classes favoring the class taught by interns. However, when comparisons were made between mathematics interns and their colleagues, higher test scores occurred in the colleagues classes. Collectively, these analyses do not suggest the intern's students outperformed students in classes of more experienced colleagues, but this collective analysis does suggest that students in the interns classes performed as well on end-of-year curriculum bound tests as their peers in classes taught by more experienced teachers. This phenomenon may be attributed to the excellent assistance and advice provided by mentor teachers to the interns' during their induction into teaching and to the interns' ability to profit from this advice by positively affecting the learning programs of their students. It is also possible that recommended protocols for planning and implementing instructional programs, which were emphasized in the course work preceding and accompanying the internship, influenced the teaching behavior of the interns. Without evidence to the contrary it appears that both the experiential and empirical perspectives of the program's content contributed to the interns' success in fostering student academic attainment.

Another characteristic of the process-product research paradigm (i.e., class observations) was incorporated into this program's evaluation effort. Actual classroom observations were completed by trained teacher appraisers, video-recordings of entire class sessions were made and analyzed with a low-inference observation system, and

student assessments of the intern's teaching skills were collected. These sources provided similar findings regarding the frequent occurrence of recommended instructional protocols. Interns were sufficiently influenced by the pedagogical course work preceding and accompanying the internship to effectively demonstrate desired teaching behaviors as judged by students, school district teacher appraisers, and university researchers analyzing the video recordings. In this case, the data suggest the empirical perspective of the program's content illustrated by the oft cited work of Good, (1979), Good & Grouws (1979); Brophy, (1983); Stallings, Needels & Stayrook, (1979), was manifested in the teaching behaviors of the interns.

Other observations drawn from individual conversations, class discussions, and debriefings of video-taped lessons revealed moderate appreciation of the complexity of teaching and the underlying principles from the social sciences or theoretical perspective of the program which apply to classroom events. The most convincing evidence that interns actually tried to integrate "theory" with instructional and curricular issues was exhibited in the end of year essays and reports of their instructional investigations. These initial attempts at "reflective teaching" may appear superficial and narrow to the veteran teacher, but from experience with the interns throughout the program, these responses represent a truly significant change in their orientation to teaching. Until the latter stages of the program interns appeared to be interested mainly with classroom survival techniques, yet their written responses to essays and research reports revealed an intellectual synthesis of pedagogical concepts with their professional roles as caring, thinking teachers. These written

products represent the most tangible and telling evidence that the theoretical perspective of the curriculum influenced the professional development of the interns.

Two integral processes associated with the program were examined in some detail. These processes were the collaboration between school districts and university, and the recruitment and selection of participants for the program. As noted in the results, shared decision-making between school districts and the university resulted in paid internships being incorporated in the program. Further, through the influence of the advisory panel, criteria were developed and implemented which required participating school districts to have operational staff development programs in place for new faculty. These participation criteria for school districts also included the easement to collect classroom observation data and student achievement data for the purposes of program evaluation. Collaboration between school districts and the university evolved from sharing perspectives and influencing policies to being equal legal partners in the non-traditional certification program.

The other process, recruiting and selecting interns for the program, involved substantial cooperation between school districts and the university. Factors beyond the control of the school districts and university, such as the depressed economy in Texas, reduced the participation of a number of school districts and dramatically affected the number of placements. Yet the program endured and has begun to expand due to the flexibility, industry and commitment of key individuals in school districts and the university.

CONCLUSIONS

This program was developed to permit individuals with extensive academic credentials in mathematics and/or science to become certified secondary teachers. Information presented in this paper indicates participants of the program successfully demonstrated desired teaching skills, fostered academic attainment of students, evidenced the ability to reflect on their professional roles and ultimately became certified secondary teachers. Further, participating schools and the university learned to work together to implement and continue the program beyond the period of available external funds. Yet a question remains: is the resulting curriculum for teacher preparation which integrates different epistemological perspectives applicable in different settings? At present only conjectures are possible for framing a response to this question. However when this curriculum was being developed, careful attention to the scope and sequence of pedagogical content did occur and much thought was given to the design of instructional strategies to foster the learning of this content. Assuming other settings carefully examine the structure of pedagogy and its impact on their delivery system, the potential for developing and implementing a successful program is high.

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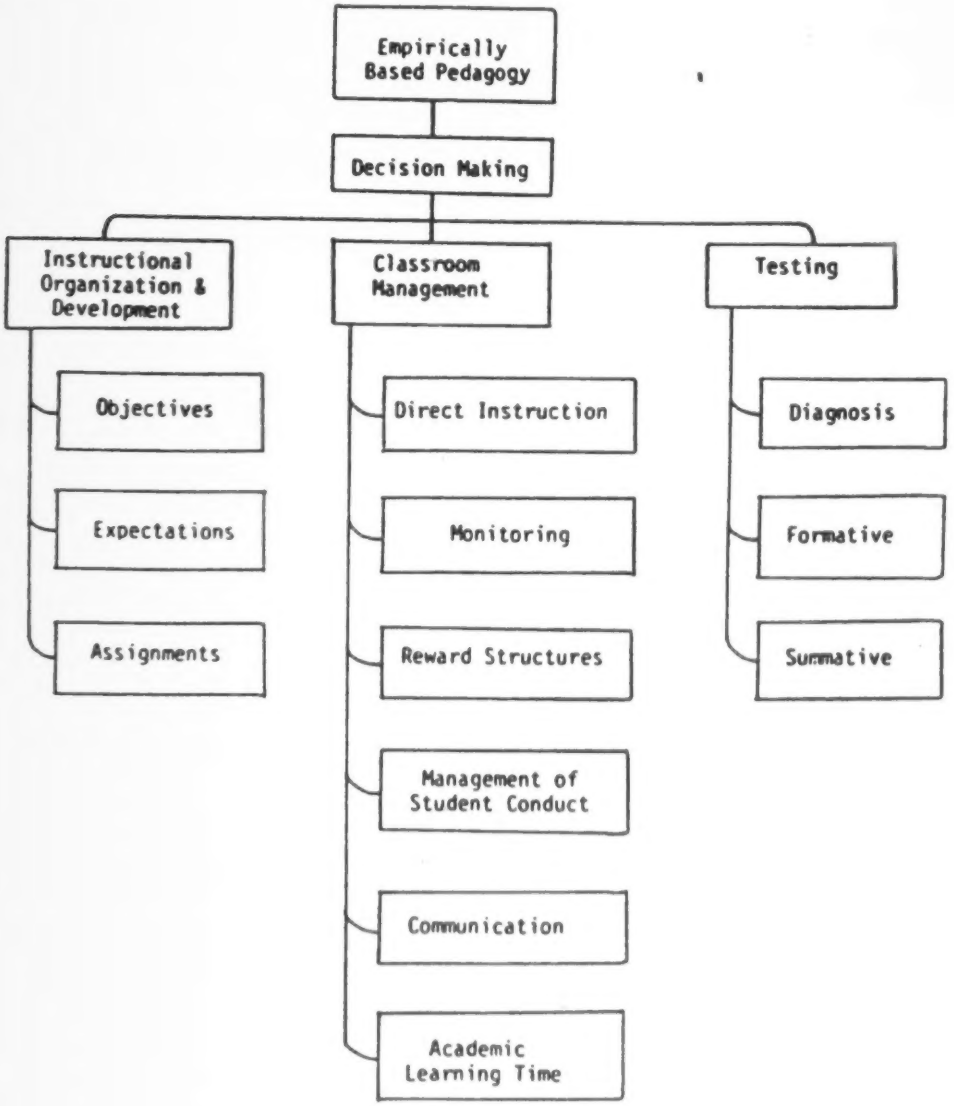
Appendix A

TABLE 1A

Example of Content Elements Selected for Content Structure of Pedagogy Based on Empirical Evidence



Example of Content Elements Selected for Content Structure of Pedagogy Based on Experience

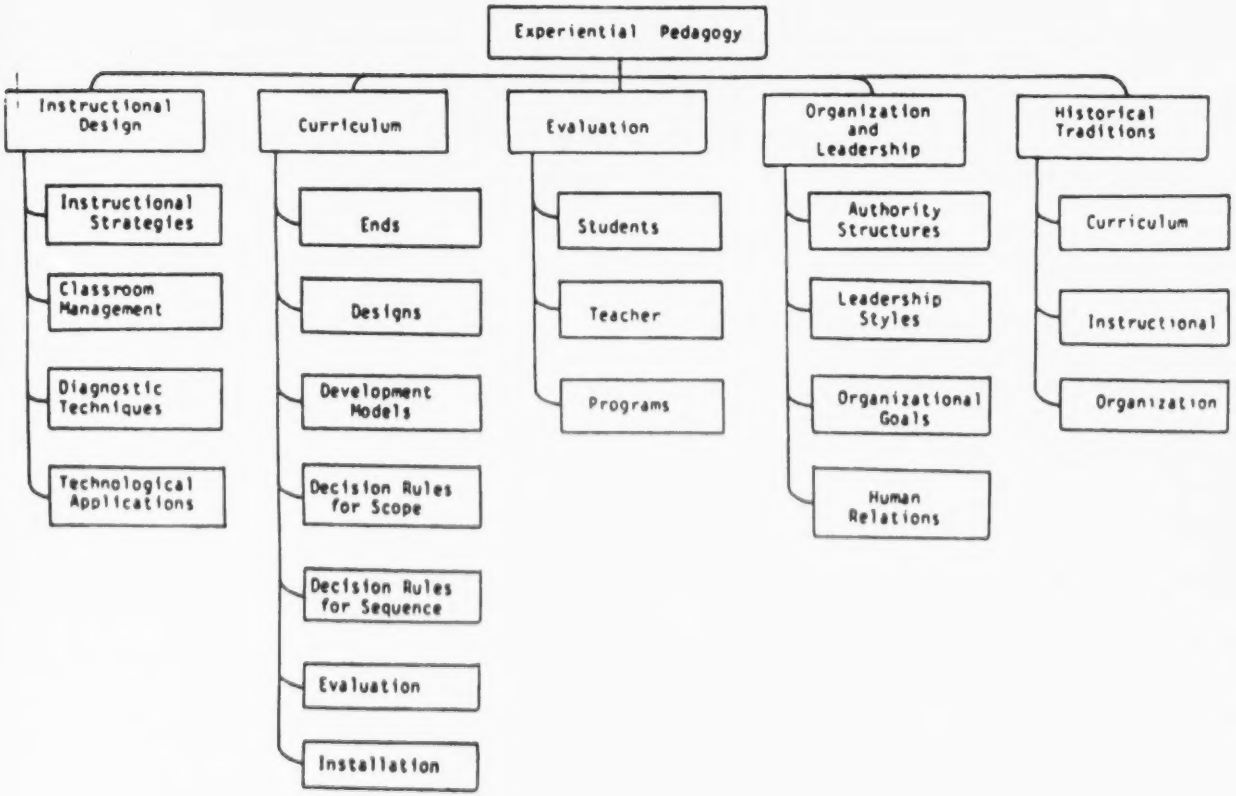
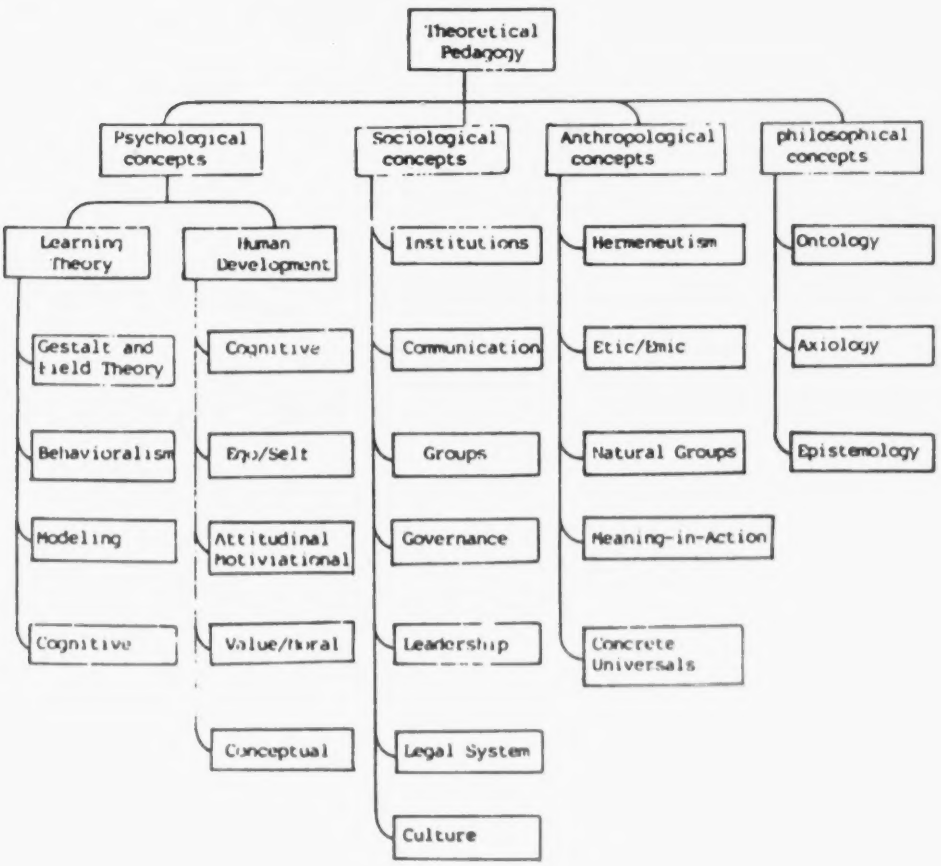


Table 2A

TABLE 3A

Example of Content Elements Selected for Content Structure of Pedagogy Based on Theory



Appendix B

THE CLASSROOM OBSERVATION SYSTEM

INTRODUCTION

The purpose of the Classroom Observation System (COS) is to guide data collection regarding instructional moves made by the teacher during the course of a lesson. Primary attention has been given to process variables in classroom management, events-of-instruction, and instructional media. The theoretical framework is based on concepts of Gagne and Briggs (1974), Kounin (1970), and research findings on teacher effectiveness. The COS is designed to determine whether effective strategies and skills indicated by Gagne, Briggs, and Kounin can be identified in the process behaviors exhibited by the teacher during instruction. This instrument can be used in all subject areas and in different grade levels. Yet, it is designed for use in a large group instructional setting with instruction directed and controlled by the teacher.

The Coding System

The COS is comprised of three sections for investigating teacher behavior: classroom management, events-of-instruction, and media. The classroom management section is composed of 7 categories which focus the observer's attention on effective teaching strategies dealing with attracting and maintaining student attention, preventing misbehavior and maximizing the instructional time. The events-of-instruction section contains 10 categories and permits the recording of teacher skills in implementing a lesson. The media section contains 12 categories which permits the recording of instructional resources a teacher used during lesson.

A coding sheet of the COS is provided in figure 1. All code categories under each of the three dimensions are provided on the left-hand side of the coding sheet. The sixty horizontal rows on the right-hand side of the coding form represent coding opportunities for one hour of instruction. Each row represents a coding interval of one minute. The three columns across each minute interval delimit the three dimensions of interest. Phenomena from each dimension which occur during a particular time interval should be coded.

Prior to coding teacher behaviors, descriptive information needs to be completed regarding the name of the teacher being observed, the class period, the date, and beginning time of the observation.

Definitions of code categories under each of the three dimensions are provided in the appendix. Observers who are interested in using this instrument are strongly urged to carefully review these definitions and groundrules.

USING THE COS INSTRUMENT

The COS is designed to be used in actual classrooms or with video-transcribed lessons. Observations of the class are recorded at one minute intervals across the three classifications. It is important that some variable be coded for each classification each minute. This procedure permits monitoring the type of activity occurring within each classification over time as well as the interaction of one classification with another. For example, the frequency of slides being used during a 15 minute presentation of

new information can be determined with this system as well as determining whether slides are used more extensively than other types of media.

Coding begins by recording the type of classroom management variable being exhibited; column I, row 1 (first minute). Next, a categorizing decision is made regarding the events-of-instruction in column II, row 1. Finally, the observer shifts attention to the media support being used by the instructor in column III, row 1. This process is repeated throughout the lesson or observation period. If transitions and multiple categories occur during the minute interval, more than one code may be placed in a cell. Each code category, however, should be marked only once in the cell during a one-minute interval. It is expected that at least one code be entered in each cell. When an event or category occurs at the juncture between minutes, then record the event in the cells for both minutes.

The following protocol is recommended when the CUS is being applied to a video recorded lesson. This protocol requires the coder to view the lesson twice. During the first viewing the observer records in narrative form general impressions of the lesson. Following this initial viewing and recording, the lesson is then coded using the CUS. This procedure permits the coder to gain some understanding of the context of the lesson before the lesson is coded with the CUS.

Teacher: _____

Date: _____

Class period: _____

Class time: _____

I. Classroom Management

1. withitness
2. overlapping
3. transitions
4. smoothness and momentum
5. alerting
6. accountability
7. not appropriate

II. Events of Instruction

1. gaining attention
2. informing learner objective
3. stimulating recall of prerequisites
4. presenting new information
5. providing learner guidance
6. eliciting performance
7. providing feedback
8. assessing performance
9. enhancing retention & transfer
0. non-event

III. Media Support

A. chalkboard
B. transparency
C. slides
D. film
E. video tape
F. audio tape
G. microcomputer
H. chart
I. text
J. model
K. other
L. not applying media

Observer: _____

Date: _____

Time	I	II	III	Comments
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2				
3				
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CODING CONVENTIONS FOR COS-(DEFINITIONS OF CATEGORIES AND CODING GROUNDRULES)

I. **CLASSROOM MANAGEMENT:** This classification is based on the work of Kounin(1970). Kounin's work indicates that effective classroom management is evidenced through the use of techniques to prevent misbehavior while fostering student cooperation and involvement with class tasks.

1. **WITHITNESS** (early correct and appropriate reactions to potential disruptions)
   This category is coded when a teacher disciplines the deviating student, acts promptly and controls major deviancies. Students are made aware by the teacher's action that he/she (the teacher) knows exactly what they are doing. For example, when the teacher sees student A passing a note to student B, she immediately calls on student A and redirects the student to go back to work. If the teacher ignores a misbehavior, allows it to spread or extend for some time, or if she/he reprimands the wrong student, N/A (code 7) should be coded.

2. **OVERLAPPING** (dealing with multiple issues at the same time)
   This category is coded when more than one issue occurs simultaneously and the teacher is able to handle them without becoming frustrated, confused, or ineffective. Particularly, students should not be left waiting for the teacher. For example, the teacher continues to present information while responding to a request at the door. If the teacher has to suspend or stop an event in order to attend to the other, N/A (code 7) should be coded.

3. **TRANSITIONS** (smoothly shift of activities)
   This category is coded when the teacher smoothly shifts students from one academic activity to another. Effective transitions are evidenced by students getting oriented quickly to the new activity. Materials and resources for the new activity are available and used when the activity is introduced. If the transition is slow and unorganized, N/A should be coded.

4. **SMOOTHNESS & MOMENTUM** (maintaining optimal activity flow)
   This category is coded when the lesson appears to be moving along in sequential order and at an effective pace without distractions, interruptions or delays. Begin coding this category when the instruction actually starts and continue coding this category if the lesson goes smoothly. In other words, this code should appear in every interval (after the instruction starts) if a lesson is proceeding well. A lack of smoothness and momentum are evidenced by:
   overdwelling- nagging on a point that students already understand,
   fragmentation- unnecessarily breaking down an activity into

sub-parts when it could be performed as a single unit, and jerkiness- distracting by unplanned events, sudden interruptions of the students' work, starting on an activity but leaving it hanging, or returning to a previous event while engaging in a new activity.
N/A (code 7) should be coded if any of these conditions occur.

5. **GROUP ALERTING** (keeping the whole class attentive)
This category is coded when the teacher keeps the students in suspense (on their toes) as to whether or when they will be asked to demonstrate their knowledge. Some useful techniques are: suspense before calling on students, call on students randomly, ask students to respond on another's answers, or inform students that their work will be checked soon. If the teacher becomes totally engaged with an individual or a small group of students while leaving others uncontrolled and unattended, N/A (code 7) should be coded.

6. **ACCOUNTABILITY** (Show me! Do it now and here!)
This category is coded when students are held accountable for their performance through demonstrations or providing their work (problem solutions). Accountability usually follows a forewarning by the teacher of an upcoming accounting of students' work. If the teacher did not follow-through after alerting the class on an accountability act then N/A (code 7) should be coded.

7. N/A (Not-Appropriate)
This category is coded when the teacher uses inappropriate strategies in any of the above categories. This code should be accompanied by identifying which of the above categories is not being adequately dealt with in the comments column by marking the corresponding code number.

II. **INSTRUCTIONAL EVENTS:** The categories in this classification are based on the events-of-instruction identified by Gayne and Briggs (1974). This classification was established to focus on the instructional processes occurring during a lesson.

1. **GAINING ATTENTION:**
   This category refers to an attempt to alert learners and direct their attention to a learning task. The category is coded if the teacher creates a scheme to prod the curiosity of students or simply states something like, "OK, class now attend to this idea." As a ground rule, code this category when the class begins or when the activity changes. In other words, this category goes along with TRANSITIONS in classroom management. Without the ground rule, each time the teacher moves or changes his/her voice this code could be noted. The category is significantly labeled "Gaining Attention" rather than "Maintaining Attention."

2. **INFORMING LEARNER OF OBJECTIVE:**
   This category is coded when the teacher states what the students will be able to do after they have acquired the knowledge or skill. The statement can be either oral or written or both. This category will be coded if the objective of a lesson is stated in behavioral terms, or if a definite list of ideas or information to be learned is presented, or if sample questions to be answered by students during the lesson are presented, or if a problem is presented at the outset of class and the class is informed that they will learn how to work that type of problem in class.

3. **STIMULATING RECALL OF PREREQUISITES:**
   This category includes efforts to relate prior learning to a current learning issue. Any reference to previously learned material qualifies for this category when it is related to the current class topic. As a ground rule, if the teacher refers to or asks questions about previously learned knowledge or skill and accompanies the reference with terms like, "Remember", "Last week", "Earlier",...etc., this category should be coded.

4. **PRESENTING NEW INFORMATION:**
   This category refers to the actual presentation of new information to be learned. The presentation can take the form of lecture, film, textual readings, written material presented by media, immediate examples, and illustrations that present information to be learned or performed.

5. **PROVIDING LEARNER GUIDANCE:**
   This category is closely related to presenting new information. However, it differs from simple presentation of information to be learned. Obvious provisions for providing

learner guidance include: outlines, instructional cues and prompts, instructional organizers. As a ground rule, elaborated examples, extensive explanation, and teacher's rhetorical questions that serve as cues or prompts to direct students' thought on the right track should be coded under this category.

6. ELICITING PERFORMANCE:
   This category is coded when the teacher asks an individual student or the class to answer questions, work on problems, perform a demonstration, exercise, or laboratory problem as a process of gathering information about students' learning progress. While students are performing (completing assignment such as an exercise or test) record "0" or Non-Event, since the teacher's actions are managerial rather than instructional in a strict sense. During seatwork activity by student, however, teacher responses to student questions should be coded as Feedback (7).

7. PROVIDING FEEDBACK:
   This category refers to an teacher's verbal reactions regarding a response or performance of a student or the class. The verbal reactions can take the form of comments, judgments, observations, or discussion on the correctness of an answer or performance. Providing feedback can be thought of as a formative evaluation of the learner's progress.

8. ASSESSING PERFORMANCE:
   This category refers to cumulative evidence that a topic or skill has been assimilated. Evidence in this case is considered to be present by having students show they have learned the idea or skill. Instructors are responsible for making summative judgments regarding whether enabling objectives in a lesson have been mastered. For example, when returning an exam, report or assignment the teacher informs the class as how many items or which part of problems were missed by most or a few of the students. It is reasonable to expect a greater number of category "7's" than "8's" in any lesson.

9. ENHANCING RETENTION AND TRANSFER:
   This category refers to special efforts to aid the students in retaining or transferring information. The suggestion of memory devices and periodic or spaced reviews of material during a lesson would fall under this category. Transfer refers to widening the range of situations to which the knowledge or skill can be applied or interpreted. The key to TRANSFER is it requires students to apply newly acquired knowledge or skill in a novel situation. Thus, whenever the teacher provides opportunity of novel situations to induce transfer of learned skill this category will be coded.

0. N/E (NON EVENT) :

This category is coded when events taking place in the classroom are management oriented and the teacher is not acting in an instructional role. An example of this category is when a test is being administered, the teacher's primary role in class is managing the administration of the test. Thus, the event-of-instruction appropriate for this situation is code 0 or a non event.

III. MEDIA SUPPORT: The subcategories within this classification are used to note the media support used by the teacher during each minute time unit.

A. CHALKBOARD
Instructor writes or illustrates on chalkboard then A should be recorded.

B. TRANSPARENCY
Instructor utilizes overhead projector and transparency then B should be recorded.

C. SLIDES
Slides projected by slide projector or personal viewer during instructional time unit then C should be recorded.

D. FILM
If films or filmstrips with or without soundtracks are projected during instructional time unit then D should be recorded.

E. VIDEO TAPE
If video tape is aired during instructional time unit then E should be recorded.

F. AUDIO TAPE
If audio tape is played during instructional time unit then F should be recorded.

G. MICROCOMPUTER
When microcomputers are being used during instructional time unit then G should be recorded.

H. CHART
Wall charts being referred to during instructional time unit then H should be recorded.

I. TEXT
If printed material (including textbook, handouts, tests) is being used during instructional time unit then I should be recorded.

J. MODELS
If physical models are being used during instructional time period by instructor or learner then J is recorded.

K. OTHER
If other instructional aides which have not been listed but are used during instructional time unit then K should be recorded.

L. NOT APPLYING MEDIA
Record L if instructor or student are not using media during instructional time unit.

Sources

Kounin, J. (1970). Discipline and classroom management. New York: Holt, Rinehart & Winston.

Gayne, R. M. & Briggs, L. S. (1974). Principles of instructional design. New York: Holt, Rinehart & Winston.

III. **MEDIA SUPPORT:** The subcategories within this classification are used to note the media support used by the teacher during each minute time unit.

A. **CHALKBOARD**
Instructor writes or illustrates on chalkboard then A should be recorded.

B. **TRANSPARENCY**
Instructor utilizes overhead projector and transparency then B should be recorded.

C. **SLIDES**
Slides projected by slide projector or personal viewer during instructional time unit then C should be recorded.

D. **FILM**
If films or filmstrips with or without soundtracks are projected during instructional time unit then D should be recorded.

E. **VIDEO TAPE**
If video tape is aired during instructional time unit then E should be recorded.

F. **AUDIO TAPE**
If audio tape is played during instructional time unit then F should be recorded.

G. **MICROCOMPUTER**
When microcomputers are being used during instructional time unit then G should be recorded.

H. **CHART**
Wall charts being referred to during instructional time unit then H should be recorded.

I. **TEXT**
If printed material (including textbook, handouts, tests) is being used during instructional time unit then I should be recorded.

J. **MODELS**
If physical models are being used during instructional time period by instructor or learner then J is recorded.

K. **OTHER**
If other instructional aides which have not been listed but are used during instructional time unit then K should be recorded.

L. **NOT APPLYING MEDIA**
Record L if instructor or student are not using media during instructional time unit.

Sources

Kounin, J. (1970). Discipline and classroom management. New York: Holt, Rinehart & Winston.

Gayne, R. M. & Briggs, L. S. (1974). Principles of instructional design. New York: Holt, Rinehart & Winston.

Teacher C Cumulative Data

NAME _____

SS# _____

RESC _____ SITE _____

DATE _____

TEXAS EDUCATION AGENCY

Texas Teacher Appraisal System

Observation/Evaluation Record

School Year 19___-___

Teacher _____ Assignment/Grade _____ Appraisal Period 1 or 2 (circle)

Appraiser _____ Title: Teacher's Supervisor _____ Other Appraiser _____

Subject Area Observed _____ Observation Date _____

Beginning Time _____ Ending Time _____ Scheduled _____ Unscheduled _____

TEACHER'S SUPERVISOR:

1. After each formal observation an OBSERVATION RECORD must be completed for Domains I-V. Record the date on which the OR is completed in the space provided in the upper right hand corner of this form.
2. For each indicator observed and/or credited, circle the numeral 1. Evidence concerning indicators for which credit is denied must be documented in the space provided.
3. For each criterion in which Exceptional Quality is awarded, circle the numeral 3. Evidence concerning the basis for awarding EQ credit must be documented in the space provided.
4. At the end of each appraisal period and/or prior to the summative conference, an EVALUATION RECORD must be developed. Review the completed OBSERVATION RECORD(S) and any cumulative data collected up to the end of the appraisal period to determine whether changes need to be made regarding SE and EQ credit. Record the date the EVALUATION RECORD is developed in the space provided in the upper right hand corner of this form. If after reviewing the data there are no changes to be made, complete steps 5 and 6 below. If previously awarded SE or EQ credit is to be denied, strike through the circled numeral. If credit which was previously denied is now to be awarded, circle the appropriate numeral. Initial and date each change and record documentation to substantiate the change(s) in the space provided.
5. For Domain V, credit is automatically awarded unless documentation justifies denial.
6. For each domain, record the total credits earned during the appraisal period (SE + EQ) in the space provided.

OTHER APPRAISER(S):

1. After each formal observation, an EVALUATION RECORD must be completed for Domains I-IV. Record the date on which the ER is completed in the space provided in the upper right hand corner of this form.
2. For each indicator observed and/or credited, circle the numeral 1. Evidence concerning the basis on which credit for an indicator has been denied must be documented in the space provided.
3. For each criterion for which Exceptional Credit is awarded, circle the numeral 3. Evidence concerning the basis for awarding EQ credit must be documented in the space provided.
4. For each domain, record the total credits earned in the space provided.
5. If the teacher's supervisor has scored the teacher's performance in Domain V less than satisfactory, review documentation and score Domain V.

I. Instructional Strategies

		SE
1. Provides opportunities for students to participate actively and successfully.	a. varies activities appropriately	1
	b. interacts with group(s) appropriately	1
	c. solicits student participation	1
	d. extends responses/contributions	1
	e. provides time for response/ consideration	1
	f. implements at appropriate level	1
	Exceptional Quality	3
2. Evaluates and provides feedback on student progress during instruction.	a. communicates learning expectations	1
	b. monitors student performance	1
	c. solicits responses/demonstrations for assessment	1
	d. reinforces correct response/ performances	1
	e. provides corrective feedback/ clarifies/none needed	1
	f. reteaches/none needed	1
	Exceptional Quality	3
	FOR EVALUATION RECORD DOMAIN CREDIT TOTAL	

II. Classroom Management and Organization SS# _____

3. Organizes materials and students.

a. secures student attention 1
b. uses procedures/routines 1
c. gives clear administrative directions/none needed 1
d. maintains appropriate seating/grouping 1
e. has materials/aids/facilities ready 1

Exceptional Quality 3

4. Maximizes amount of time available for instruction.

a. begins promptly/avoids waste at end 1
b. implements appropriate sequence of activities 1
c. maintains appropriate pace 1
d. maintains focus 1
e. keeps students engaged 1

Exceptional Quality 3

5. Manages student behavior.

a. specifies expectations for behavior/none needed 1
b. prevents off-task behavior/none needed 1
c. redirects/stops inappropriate/disruptive behavior/none needed
d. applies rules consistently and fairly/none needed 1
e. reinforces behavior appropriately 1

Exceptional Quality 3

FOR EVALUATION RECORD DOMAIN CREDIT TOTAL [ ]
(SE ÷ EO)

III. Presentation of Subject Matter

6. Teaches for cognitive, affective, and/or psychomotor learning and transfer.

a. begins with appropriate introduction 1
b. presents information in appropriate sequence 1
c. relates content to prior/future learning 1
d. defines/describes concepts: skills, attitudes, interests 1
e. elaborates critical attributes 1
f. stresses generalization/principle/rule 1
g. provides for application 1
h. closes instruction appropriately 1

Exceptional Quality 3

95

III. Presentation of Subject Matter *(continued)* SS#

7. Uses effective communication skills.

a. makes no significant errors 1
b. explains content/task(s) clearly 1
c. stresses important points/dimensions 1
d. uses correct grammar 1
e. uses accurate language 1
f. demonstrates written skills 1

Exceptional Quality 3

FOR EVALUATION RECORD
DOMAIN CREDIT TOTAL [ ]
(SE + EO)

IV. Learning Environment

8. Uses strategies to motivate students for learning.

a. relates content to interests/ experiences 1
b. emphasizes value/importance of activity/content 1
c. reinforces/praises efforts 1
d. challenges students 1

Exceptional Quality 3

9. Maintains supportive environment.

a. avoids sarcasm/negative criticism 1
b. establishes climate of courtesy 1
c. encourages slow/reluctant students 1
d. establishes and maintains positive rapport 1

Exceptional Quality 3

FOR EVALUATION RECORD
DOMAIN CREDIT TOTAL [ ]
(SE + EO)

V. Professional Growth and Responsibilities

10. Plans for and engages in professional development.

a. progresses in growth requirements or none needed 1
b. stays current in content taught 1
c. stays current in instructional methodology 1

V. Professional Growth and Responsibilities *(continued)*

Teacher _____

11. Interacts and communicates with parents.	a. initiates communications with parents as appropriate	1
	b. conduct conferences with parents in accordance with local policy	1
	c. reports student progress to parents	1
	d. maintains confidentiality	1
12. Complies with policies, operating procedures, and requirements.	a. follows TEA requirements	1
	b. follows district/campus policies/ procedures	1
	c. performs assigned duties	1
	d. follows promotion procedures	1
13. Promotes and evaluates student growth.	a. participates in goal-setting	1
	b. plans instruction	1
	c. documents progress	1
	d. maintains records	1
	e. report . og	1

FOR EVALUATION RECORD DOMAIN CREDIT TOTAL [ ] (SE)

Comments:

Teacher Signature/Date Received OR	Appraiser Signature/Date Completed OR	Date of Conference (if any)
Teacher Signature/Date Received ER	Appraiser Signature/Date Completed ER	Date of Conference (if any)

(The signature of the teacher indicates that he/she has reviewed and received a copy of this record.)

Original Copy—Central Office
Copy #2—Teacher's Supervisor

N

COMPARISON AND CONVERSION OF 1986 VERSION TO 1987 VERSION OF THE TEXAS TEACHER APPRAISAL SYSTEM (TTAS)

SECTIONS 1 through 4 equivalent in both editions (versions)

	1986		1987
SECTION 5			
	DELETE 5d		
	DELETE 5e		
	5f	becomes	5d
	5g	becomes	5e
SECTION 6	equivalent in both editions (versions)		
SECTION 7	7a	---------	7a
	DELETE 7b		
	7c	becomes	7b
	7d	becomes	7c
	DELETE 7e		
SECTION 8	8a	becomes	7d
	DELETE 8b		
	8c	becomes	7e
	8d	becomes	7f

SECTION 9 (1986 VERSION) becomes SECTION 8 (1987 VERSION)

SECTION 10 (1986 VERSION) becomes SECTION 9 (1987 VERSION)
DELETE 10d (86 version)

SECTION 11 (1986 VERSION) becomes SECTION 10 (1987 VERSION)

SECTION 12 (1986 VERSION) becomes SECTION 11 (1987 VERSION)

SECTION 13 (1986 VERSION) becomes SECTION 12 (1987 VERSION)

SECTION 14 (1986 VERSION) becomes SECTION 13 (1987 VERSION)

Student Questionnaire About The Teacher and The Class

DIRECTIONS

This is a questionnaire consisting of 46 items which has been developed to determine your opinion and feelings about the instruction provided in this course by the teacher. Please respond to all items by shading in your choice in the designated place on the answer sheet. Use the following answer key to respond to all items.

A - Strongly agree
B - Agree
C - Undecided
D - Disagree
E - Strongly disagree

EXAMPLE

50. The content studied in this course is difficult

50. (A) (B) (C) (D) (E)

Suppose the student agrees with this statement, he would then shade in B for item 50.

---

1. The teacher encourages students to participate in class rather than just listen.

2. The teacher instructs using more than one approach, that is, large group, small group and to individuals.

3. The teacher encourages and calls on non-volunteers to participate in class.

4. The teacher provides time for students to respond to instructional questions.

5. The teacher instructs the class at an appropriate level, not too difficult and not too easy.

6. The teacher communicates to students what they are to learn as a result of the lesson.

7. The teacher asks students to demonstrate they know the material in a lesson.

8. The teacher tells students when their answers are correct and complete.

9. The teacher reteaches a topic a different way if the class does not understand.

10. The teacher gains student attention before directions are given for a class activity.

11. The teacher distributes and collects class materials efficiently not wasting class time.

12. The teacher gives clear directions for classroom procedures and routines.

13. The teacher has materials, equipment, and the laboratory ready when class begins.

14. The teacher always begins class promptly.

15. The teacher avoids wasting time at the end of the period.

16. The teacher makes sure that activities occur in a sequence that makes learning easy.

17. The teacher maintains proper pace with the lessons, that is, the lessons do not drag or seem to be hurried.

18. The teacher stays on the topic.

19. The teacher explains expectations for class behavior.

20. The teacher identifies students who are doing something other than the assigned task and guides them back to their class work.

21. The teacher applies the conduct rules of class fairly and consistently to all class members.

22. The teacher offers praise to the class and to individuals when behavior is appropriate.

23. The teacher begins class by directing student attention to the purpose of the activity.

24. The teacher relates the content of the lesson to previous lessons or experience.

25. The teacher introduces topics with clear definitions or descriptions of the new information.

26. The teacher uses clear examples to explain new ideas.

27. The teacher often stresses the principles which relate the terms to one another.

28. The teacher provides opportunities to apply rules or principles in new problems and situations.

29. The teacher summarizes the main points of a lesson at the end of the period.

30. The teacher exhibits mastery of the course content.

31. The teacher uses words and vocabulary to explain the content in a way that is understandable.

32. The teacher stresses the important points of content in a lesson.

33. The teacher will explain some point again after students indicate they do not understand.

34. The teacher uses correct grammar in speaking and writing.

35. The teacher pronounces words correctly and clearly.

36. The teacher does not overuse vague terms in speaking and writing.

37. The teacher relates class content to student interests.

38. The teacher emphasizes the value of the content or lesson to students.

39. The teacher communicates an awareness and appreciation of student effort and progress.

40. The teacher challenges students to succeed at difficult tasks.

41. The teacher avoids sarcasm and negative criticism to students.

42. The teacher listens to and responds to student questions.

43. The teacher requires that students listen to each other in class discussions and encourages cooperation and courtesy.

44. The teacher praises students for specific performances.

45. The teacher relates to students in a pleasant manner.

46. The teacher asks questions in class and on tests which make me think.

NABT/NSTA High School Biology Examination Version 1987 B

This examination was prepared by members of the high school biology examination development committee appointed by the National Association of Biology Teachers and the National Science Teachers Association.

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To the Student: An understanding of basic biological concepts is critical for you to be an effective citizen in the global biological community. The purpose of this test is to help you and your teacher evaluate your understanding. You are sharing this experience with other high school students across the nation. Read the following seven directives before you begin this test. Good luck.

1. DO NOT OPEN this examination booklet until you are asked to do so by your teacher.
2. DO NOT WRITE anything in the examination booklet. Your teacher will provide you with an answer sheet and scrap paper.
3. Copy the VERSION NUMBER at the top right of this page onto your answer sheet.
4. Each question has a single best answer. When you decide which answer is correct for a question, completely blacken the corresponding space on the answer sheet with a soft pencil. Make a heavy black mark that completely fills the space to record your answer. Mark only one answer for each question. If you wish to change your answer, completely erase the first mark.
5. This examination is divided into two sections. Do not proceed to the second section until your teacher tells you to do so.
6. Your score on this examination is equal to the number of correct answers given. It is to your advantage to answer every question in the section assigned by your teacher.
7. When you are instructed to stop working, put down your pencil, close this examination booklet, and await instructions from your teacher.

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Part I

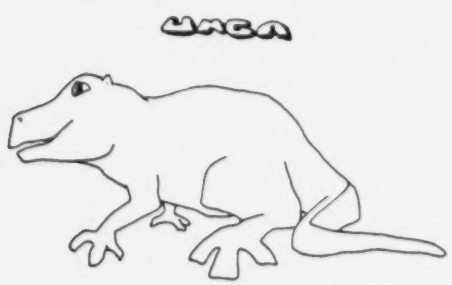
1. In a multicellular animal, a cell is a unit of structure as well as a unit of

   a. organ systems.
   b. mutation.
   c. function.
   d. natural selection.
   e. meiosis.

2. The primary source of energy for living organisms on earth is

   a. sunlight.
   b. water.
   c. electricity.
   d. gravity.
   e. oxygen.

3. An Unga is an imaginary animal with a large number of hereditary traits that follow basic Mendelian principles. The following is a drawing of an Unga.



   When a homozygous, long-eared Unga is crossed with a short-eared one, all the offspring are medium-eared. When a medium-eared Unga is crossed with a short-eared one, what proportions would you predict for the offspring?

   a. 100% medium-eared
   b. 100% short-eared
   c. 50% long-eared, 50% medium-eared
   d. 50% medium-eared, 50% short-eared
   e. 50% long-eared, 50% short-eared

4. The human genes responsible for producing insulin and human growth hormone have been successfully transplanted into bacteria *(E. coli)*. The bacteria then produce these human hormones. The fact that human genes can function normally in bacteria is evidence that all living organisms

   a. have the same DNA code sequence.
   b. have a universal DNA language.
   c. secrete the same hormones.
   d. are closely related structurally.
   e. reproduce similarly.

5. Considering the function it performs, which part of the heart would likely have the thickest wall?

   a. left ventricle
   b. right ventricle
   c. aorta
   d. superior vena cava
   e. left atrium

6. A researcher ground up plants of the *Solanaceae* family and tested them for mercury content. The most reasonable hypothesis this researcher might be testing would be that

   a. greater exposure to sunlight will decrease the quantity of mercury found in these plants.
   b. leaves will contain more mercury than will roots.
   c. plants in this family do not require mercury.
   d. some species of plants in this family take up more mercury than others.
   e. increased amounts of mercury will improve the growth rate of these plants.

Use the chart below to answer question 7

Organism	Class	Flower Parts	Leaf Form	Venation	Leaf Arrangement
Bamboo	Monocots	3s	Pinnate Simple	Parallel	Whorled
Sweetgum	Dicots	4-5s	Palmate Simple	Netted	Alternate
Horse Chestnut	Dicots	4-5s	Palmately Compound	Netted	Opposite
Ash	Dicots	4-5s	Pinnately Compound	Netted	Opposite

7. If you were to design a taxonomic key to identify and distinguish between these plants, you could base this key entirely on which characteristic?

   a. venation
   b. flower parts
   c. leaf form
   d. class
   e. leaf arrangement

The following paragraph describes a phenomenon. Notice that certain parts are underlined. Each underlined part is one of the test questions. Your job is to identify each of the underlined statements. The question number is IN FRONT of the underlined statement. Match the numbered phrase with the correct lettered term. Answers may be used more than once.

(8) Thousands of birds migrate each year. They travel many miles to distant places and then return to their original place. (9) It has long been a mystery how they find their way. Some biologists have suggested that (10) the birds guide themselves by the earth's magnetic field.

KEY:

a. hypothesis
b. problem
c. observation
d. deduction
e. interpretation of data

11. In the 1700s and early 1800s protists were not studied as much as plants and animals, partly because
    a. scientists did not know protists existed then.
    b. protists were not interesting enough to study.
    c. laws forbade the study of protists then.
    d. people believed protists were the work of "evil spirits."
    e. instruments and techniques had not been developed well enough to study protists.

12. When human red blood cells are placed in a 0.1% salt solution, they swell and burst. Which of the following modifications might prevent bursting?
    a. Remove some of the salt from the solution.
    b. Remove some cells from the solution.
    c. Add more salt to the solution.
    d. Add more water to the solution.
    e. Add more cells to the solution.

13. When plant tissues are boiled, their enzymes cease to function. That is because
    a. enzymes work only in living cells.
    b. the activation energy becomes greater than the heat of reaction.
    c. the substrate molecules are moving too fast to react.
    d. some bonds holding the enzyme's special shape are broken.
    e. the reverse reaction becomes more rapid than the forward reaction.

14. The genetic code in DNA is written in the sequence of
    a. phosphate groups.
    b. ribose molecules.
    c. deoxyribose molecules.
    d. carboxyl groups.
    e. nucleotide bases.

15. The human fossil record indicates that
    a. humans and dinosaurs lived at the same time.
    b. humans and apes had a common ancestor.
    c. humans descended directly from monkeys.
    d. humans are more closely related to orangutans than to chimpanzees.
    e. the sequence of human evolution is completely known to scientists.

16. Some biologists are measuring the O_2 consumption of a lizard and a field mouse of similar size. They slowly lower the temperature from 30° Celsius to 20° Celsius. What can you predict about the oxygen intake of these animals?
    a. Both animals will decrease oxygen intake as the temperature decreases.
    b. Neither animal will take in oxygen.
    c. The lizard will use less oxygen and the mouse will use more as the temperature drops.
    d. Both animals will increase oxygen intake as the temperature goes down.
    e. The lizard will use more oxygen and the mouse will use less as the temperature drops.

17. Consumers depend upon producers for their energy. The energy trapped by producers is
    a. used by consumers only.
    b. totally used by producers themselves.
    c. not used by consumers.
    d. partially available to consumers.
    e. totally available to consumers.

18. Organisms are often classified on the basis of structural similarities. These similarities show the degree of relatedness. Which of the following groups of organisms includes those that are most closely related?
    a. whale, penguin, octopus, squid
    b. fish, crayfish, starfish, jellyfish
    c. human, bird, lizard, salamander
    d. horse, dog, cat, mouse
    e. spider, ant, crayfish, centipede

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19. When testing the effect of a reward on the ability of mice to complete a maze in the shortest period of time, the control group should be

a. a group of mice already trained to know the maze.
b. a group of mice never tested in the maze.
c. a group of mice given no reward for completing the maze.
d. a group of mice given a reward for completing the maze.
e. a group of mice randomly given a reward or not given a reward for completing the maze.

20. In humans, birth defects occur in approximately 6 percent of all births. The rate of birth defects is 1 percent in natural pregnancies that are initiated by frozen sperm. Which hypothesis best accounts for this difference?

a. A high proportion of abnormal sperm is killed by freezing.
b. Freezing causes healthy sperm to move more slowly.
c. The freezing process ensures that egg implantation will occur.
d. A high proportion of normal sperm is killed by freezing.
e. In this process doctors implant only healthy developing eggs.

Refer to the diagram and information below for questions 21 and 22.

AGAR CUBES	SIZE
I	.05 mm on a side
II	.1 mm on a side
III	.2 mm on a side
IV	.4 mm on a side
V	.8 mm on a side

Surface area of a cube = length × width × number of surfaces
Volume of a cube = length × width × height

21. In which agar cube would diffusion of vital substances be most efficient?

a. III
b. IV
c. II
d. I
e. V

22. Which of the following is most important when considering efficiency of diffusion of materials into cells for cell survival?

a. type
b. surface area/volume ratio
c. weight
d. surface area
e. volume

23. A crimson maple is a tree that has red leaves throughout the year. Which one of the following statements is correct?

a. Photosynthesis does not take place in the leaves of the crimson maple.
b. The crimson maple must obtain its food from the soil in which it grows.
c. The maple must get energy from stored food in its roots.
d. The maple has chlorophyll, but the chlorophyll is masked by red pigment.
e. The maple must be more closely related to the red algae (Rhodophyta) than to other maples.

24. Albinism is the lack of pigment in the skin and hair. This trait is recessive to normal pigmentation. A male albino mates with a normally-pigmented female. They have an albino son. Based on that information, one can be certain that

a. albinism is an X-linked trait.
b. the female parent is homozygous.
c. the female parent is heterozygous.
d. the male parent is heterozygous.
e. the offspring exhibits nondisjunction.

25. Mitochondria contain their own DNA. This indicates that mitochondria might be

a. used in studies of the behavior of seed plants.
b. involved in secretion.
c. the suicide sacs of the cell.
d. capable of making their own food.
e. descended from ancient prokaryotes.

26. The principle of division of labor in multicellular organisms involves the

a. growth of more cells to do the work required.
b. production of cells that have different functions.
c. competition of organisms.
d. production of only one type of cell.
e. production of varied agricultural crops.

27. A student found a particular pond community to consist primarily of turtle, bass, snail, algae, and fungi populations. The producer in this community would be the

a. turtle.
b. fungi.
c. snail.
d. algae.
e. bass.

28. The bat is a small, flying, warm blooded animal with fur. Of the following, the closest relative of the bat is the

a. ostrich.
b. robin.
c. rat.
d. crow.
e. penguin.

29. Which of the following is **NOT** a major function of genetic counselors?

a. finding sources of medical help
b. explaining the genetic basis for different genetic conditions
c. drawing family pedigrees
d. telling couples that they must not have children
e. showing how traits are inherited

30. A student covered one leaf of a healthy geranium plant tightly with black paper and tape. After two days in a sunny greenhouse, two leaves were removed from the plant—one that had not been covered and the one that had been. The leaves were gently boiled in alcohol to remove their chlorophyll. Iodine was applied to both leaves to detect the presence of starch. Which results would you expect?

a. The iodine would react with leaf enzymes to form starch.
b. The uncovered leaf would contain more starch than the covered leaf.
c. Neither leaf would show the presence of starch.
d. Both leaves would show the presence of starch.
e. The covered leaf would contain more starch than the uncovered leaf.

31. Color blindness is an X-linked recessive condition. Which parental genotypes below would result in children who are all normal daughters and all color-blind sons? (B = allele for normal color vision, b = allele for color blindness.)

a. X^BX^b X^bY
b. X^bX^b X^bY
c. X^BX^B X^bY
d. X^BX^b X^BY
e. X^bX^b X^BY

32. The production of a small number of eggs is usually associated with

a. hermaphrodism.
b. asexual reproduction.
c. internal fertilization.
d. external fertilization in amphibians.
e. external fertilization in fish.

33. Binocular vision and the overlapping of the visual fields of both eyes enable people to

a. have peripheral vision.
b. have mosaic vision.
c. have depth perception.
d. distinguish colors.
e. see in the dark and in very dim light.

34. After a recent California earthquake, a new outcrop of granite emerged in a forest area. The first organisms to pioneer this rocky area would probably be

a. lichen.
b. beach willows.
c. liverworts.
d. ferns.
e. grasses.

35. A reporter wrote: "We are lucky that heart disease is not a dominant disorder, or everyone would have it by now." The reporter has made an error by assuming that

a. heart disease might be inherited as a single-gene disorder.
b. human populations follow the laws of heredity.
c. recessive traits are always weak.
d. dominant genes eventually become the most frequent genes in a population.
e. heart disease is a major cause of death in the U.S.A.

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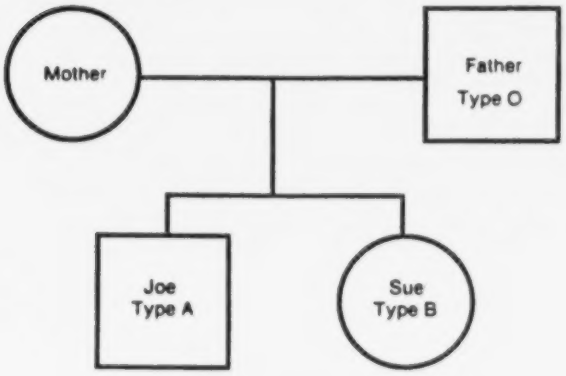
36. The family pedigree diagramed below indicates the known blood types of its members. What is Joe's probable genotype?



a. homozygous OO
b. heterozygous AB
c. heterozygous AO
d. heterozygous BO
e. homozygous AA

37. A biologist in the 1800s found two forms of mice in a valley: those that had slight toe webbing, and those that had no toe webbing. The damming of a river in 1900 made much of this mouse habitat marshy. Research today shows that the large majority of mice in the valley have webbed toes. Very few, if any, of the non-webbed variety can be located. Which statement best explains the observed change in the mouse population?

a. The presence of webbed toes in mice is controlled by more than one gene.
b. Non-webbed mice grew webbing on their feet because it helped them to run and move in the watery environment.
c. Because the mice ran in the marshy conditions, most of them developed the webbed trait, which is controlled by a recessive gene.
d. Dampness in the mouse habitat increased the rate of mutation in the mouse population.
e. Mice with toe webbing survived at a higher rate, and reproduced more frequently than did the non-webbed form of the mice.

38. An 8 g water lily was placed in a 100-liter aquarium filled with spring water. The aquarium was lighted with a fluorescent lamp, kept at room temperature, and air was bubbled through the water. Water was replaced as it evaporated. After four weeks, the water lily had grown to 20 g. Where did the additional plant mass come from?

a. both the air and the water
b. the air alone
c. the minerals in the spring water
d. the water, since it has more mass than the air
e. the light that was used

39. People who have red hair usually have freckles. This can best be explained by

a. dominance.
b. independent assortment.
c. polyploidy.
d. the law of segregation.
e. linkage.

40. The forelimbs of mammals contain an upper bone called the humerus and two lower bones called the ulna and radius. These are found in mammals as varied as the bat, the dog, humans, and the rat. This skeletal arrangement is also found in prehistoric mammals. The best interpretation for this similar skeletal structure found in so many different mammals is that

a. similar skeletal structure in these animals is due to chance.
b. common ancestry of these animals gives them a similar skeletal structure.
c. two bones in the lower forelimb are required to support the single bone in the upper forelimb.
d. all mammals have this similar skeletal structure because all mammals have identical genes.
e. similar use of the forelimbs in these animals has resulted in a similar skeletal structure.

END OF PART I

DO NOT TURN THE PAGE UNTIL INSTRUCTED TO DO SO

PART II

41. Viruses do not contain ribosomes. Therefore, viruses
    a. depend on a host organism to produce their protein.
    b. do not contain genetic material
    c. are incapable of using proteins.
    d. substitute carbohydrates for proteins.
    e. do not contain protein.

42. Fermentation (anaerobic respiration) is less efficient than aerobic respiration because fermentation
    a. requires the use of more enzymes than aerobic respiration.
    b. results in the formation of monosaccharides.
    c. does not convert as much chemical energy to ATP.
    d. uses oxygen to form carbon dioxide but not water.
    e. releases greater amounts of energy as heat into the environment.

43. In a certain species of animals, black fur (B) is dominant and white fur (b) is recessive. The percentage of white animals (bb) is 36 percent. According to the Hardy-Weinberg Principle, the percentage of heterozygous black animals would be
    a. 24%.
    b. 48%.
    c. 16%.
    d. 36%.
    e. 64%.

44. Sexual reproduction in organisms
    a. produces equal numbers of males and females.
    b. creates new combinations of alleles.
    c. creates new genes.
    d. allows for a method of separating species.
    e. is necessary for continuation of all species.

45. Plant leaves are often broad and flat. A possible benefit of this shape is that it
    a. facilitates conservation of water in leaf cells.
    b. allows maximum penetration of sunlight to leaf cells.
    c. promotes monosaccharide conversion to polysaccharides.
    d. promotes distribution of sugars to the plant roots.
    e. serves to absorb CO_2 from the atmosphere.

46. In a typical ecosystem everything cycles with the exception of
    a. oxygen.
    b. nitrogen.
    c. water.
    d. energy.
    e. carbon.

47. Bacteria and blue-green algae are placed in the same kingdom because
    a. they have flagella.
    b. they produce spores.
    c. they do not have nuclei.
    d. they do not have cell walls.
    e. they have many small nuclei.

Refer to the following information for questions 48 and 49.

Two behavioral biologists were working with young ducks. They made a cardboard model of a bird and suspended it from a wire that was stretched between two trees. The biologists remained hidden, but were able to move the model along the wire in either direction. When the model was moved to the left, it resembled a goose; when moved to the right, it resembled a hawk.

The investigators moved this model within view of some ducklings that had never seen any birds other than ducks. When the model was stationary, the ducklings showed no alarm. When the model was pulled to the left, the ducklings showed no alarm. When it was pulled to the right, the ducklings ran for cover.

48. Which of the following is true for this statement: Ducklings appear to depend on a combination of motion and shape to distinguish between hawks and geese.
    a. No data are required to support this fact.
    b. The data tend to refute the statement.
    c. The data neither support nor refute the statement.
    d. The data tend to support the statement.
    e. The experimental design was poor.

49. Which of the following is true for this statement: Ducklings appear to depend only upon motion to distinguish between hawks and geese.
    a. The experimental design was poor.
    b. The data tend to refute the statement.
    c. The data tend to support the statement.
    d. The data neither support nor refute the statement.
    e. No data are required to support this fact.

50. When rain passes through air pollutants such as sulfur dioxide, acid rain falls. The biological effect may be

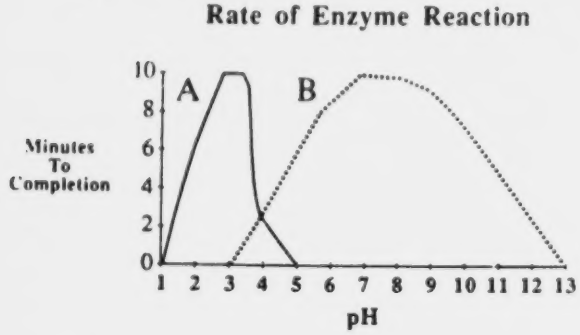
a. lowered pH in ponds, inactivating certain enzymes.
b. raised pH in ponds, encouraging the growth of weedy pollutants.
c. raised pH in ponds, causing breakdown of cell membranes.
d. lowered pH in ponds, killing all living organisms.
e. neutralization of pond water, causing dissolved oxygen to be depleted.

51. Cell membranes

a. contain proteins that actively transport some substances across the membrane.
b. contain DNA.
c. allow everything except fat-soluble substances to enter the cell.
d. are built through the activity of mitochondria.
e. are made of cellulose and give form to the cell.

Use the graph below to answer questions 52 and 53.

52. This graph represents the activity of enzymes A and B. Each is found in the human body. Both break down food substances. Temperature, enzyme concentration, and substrate concentration remain constant.



Which conclusion is most consistent with the data?

a. Neither enzyme could function in the stomach.
b. Both enzymes could function in the mouth.
c. Enzyme A is probably found in the stomach.
d. Enzyme B is probably found in the stomach.
e. Enzyme A is probably found in the mouth.

53. Which of the following is the independent variable in the graph?

a. time
b. pH
c. rate of reaction
d. enzyme concentration
e. temperature

54. One major function of meiosis is to

a. maintain a constant chromosome number in the species.
b. prevent genetic recombination.
c. lower the rate of crossing-over among chromosomes.
d. produce identical gametes.
e. produce mutations.

55. A mountain range divides a species into two populations. The environments on each side of this barrier are different. After a considerable length of time, the populations differ so much that they can no longer interbreed. This is an example of

a. convergent evolution.
b. homology.
c. analogy.
d. divergent evolution.
e. Lamarckian evolution.

56. During an operation, a surgeon removed the liquid contents from the patient's digestive tract. Lab analysis revealed that the contents consisted of proteins, peptides, complex lipids, vitamins, minerals, enzymes, hydrochloric acid, and water. Which of the following was the most likely site of the contents?

a. the pylorus of the stomach
b. the small intestine
c. the ascending portion of the colon
d. the descending portion of the colon
e. the esophagus

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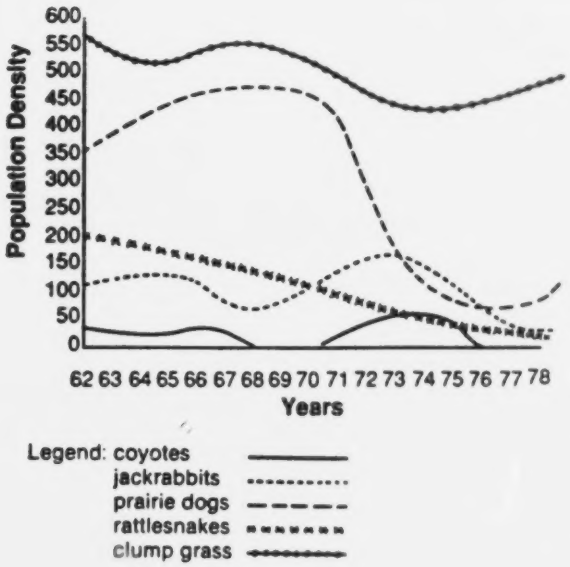
57 The following graph represents a food web observed in a desert area between 1963 and 1977. Observations were made only within an area of 10 square acres.



What did the coyotes feed upon in this particular food web?

a. prairie dogs
b. rattlesnakes
c. apparently, none of the organisms shown here
d. jackrabbits
e. clump grass

58. Classification of an organism or group of organisms is based upon certain characteristics such as bone structures. These characteristics have meaning to the person doing the classification. Therefore, a taxonomic classification is a(n)

a. fact.
b. interpretation.
c. generalization.
d. theory.
e. hypothesis.

59. In testing the ability of a mouse to go through a maze in the shortest period of time, reward (food given to the mouse) should take place

a. while the mouse is in the maze.
b. just after the mouse correctly completes the maze.
c. at the end of the experiment, three weeks after it started.
d. before the mouse goes into the maze.
e. at the end of the daily testing period with the mouse.

60. The pesticide DDT was used to control mosquito larvae in a 100 acre lake. One year after the application, fish species A had a DDT concentration of .01 mg/gm, while fish species B had 0.1 mg/gm. This biological magnification implies that

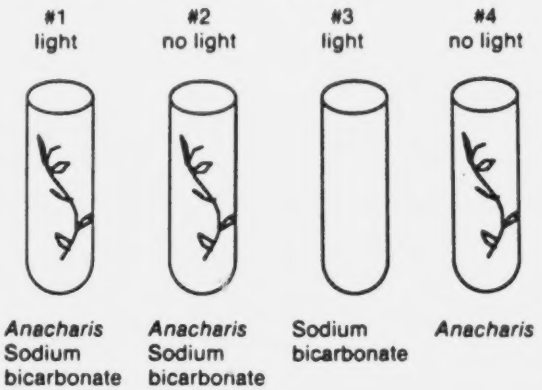
a. fish A eats fish B.
b. both are herbivores.
c. both are carnivores.
d. both are omnivores.
e. fish B eats fish A.

61. The specialized function of a cell is best indicated by

a. the size of the nucleus.
b. the number and type of organelles.
c. the structure of the cell membranes.
d. the size of the cell.
e. the absence of cell organelles.

62. Four test tubes were filled with distilled water. An aquatic plant called *Anacharis* was placed in some. Sodium bicarbonate was added to some tubes as a source of carbon dioxide. Some were placed in light, others in dark.

Study the diagrams below. In which tube(s) would you expect bubbles of *oxygen* to rise?



a. tubes 1, 2, and 4
b. tubes 1 and 3
c. tubes 2 and 3
d. tube 2
e. tube 1

63. A blue-flowered plant was cloned to produce plants with identical genetic make-ups. Clone A was grown in a medium containing a small trace of a metallic ion. Clone B was grown in the same medium without the ion. Clone A produced blue flowers. Clone B produced white flowers The data indicate that in determining flower color

a. heredity and environment contribute the same amount to gene expression.
b. environment affects the expression of certain genes.
c. environment is more important than heredity.
d. heredity controls the environment.
e. heredity is more important than environment.

64. Fifty years ago, pileated woodpeckers avoided places inhabited by humans. As the human population expanded, the number of woodpeckers decreased. Now they live close to humans in many wooded, suburban areas. Their population is growing in size. Which of the following best explains this change?

a. Certain woodpeckers learned not to fear humans and taught their offspring that way of life.
b. Individual birds evolved a more trusting lifestyle.
c. The woodpeckers learned to live with humans.
d. The birds in the population who were not afraid of humans reproduced more successfully than those who were.
e. Woodpeckers have no competition in wooded, suburban areas.

65. Growth in plants, in contrast to growth in animals,

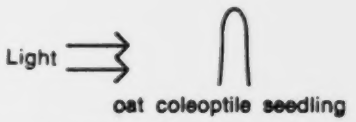
a. requires energy.
b. occurs in sunlight only.
c. proceeds at a uniform rate throughout the entire plant body.
d. proceeds only in certain regions of the plant.
e. proceeds only during photosynthesis.

66. A food chain for a prairie could be as follows: grass, rabbit, snake, hawk. The snake represents which of the following?

a. autotroph
b. third-order consumer
c. second-order consumer
d. herbivore
e. first-order consumer

67. *Sitta carolinensis* and *Sitta pygmaea* are scientific names of two living things. Which of the following is **NOT** true of these two organisms?

a. They are in the same order.
b. They are in the same phylum.
c. They are in the same species.
d. They are in the same genus
e. They are in the same family.

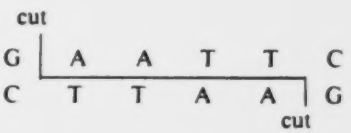


68. When the plant above is exposed to light from the left side, you would expect the plant to grow

a. to the left, due to positive phototropism.
b. to the right, due to negative phototropism.
c. to the right, due to negative geotropism.
d. straight up, due to negative geotropism.
e. straight up, due to positive phototropism.

Questions 69 and 70 are based on the following information.

The enzyme EcoR1 cuts DNA only when it recognizes the following sequence:



A = adenine
T = thymine
G = guanine
C = cytosine

A specialist in genetic engineering is working with a segment of DNA that is 500 bases long. The sequence above occurs twice: from bases 250 through 255; and from bases 315 through 320.

69. If the genetic engineer digests this DNA with EcoR1, how many DNA fragments shorter than 500 bases will result?

a. 1
b. 2
c. none
d. 3
e. 4

Go on to next page

70 By using enzymes such as EcoR1, genetic engineers can now

a. repair abnormal genes in humans.
b. insert DNA from one organism into the DNA of another organism
c. fuse together cells from different organisms.
d. determine the sequence of bases in the entire human genome.
e. cure selected genetic disorders.

71. A cell biologist hypothesized that the nucleus of a cell is necessary for cell life. She removed nuclei from a number of cells, compared them to a control group of cells with nuclei, and collected the following data:

Number of Cells Still Alive

Days After Removing Nucleus	Without Nucleus	With Nucleus
1	81	79
2	62	78
3	20	77
4	0	74
15		67
30		65

Based on those data, the biologist would reasonably conclude that a cell

a. needs a nucleus to reproduce.
b. needs a nucleus to survive more than a few days.
c. can live only one day without a nucleus.
d. cannot divide without a nucleus.
e. cannot live without a nucleus.

72. Cells complete the release of energy from glucose and its storage in ATP in organelles called mitochondria. Knowing this function, we might hypothesize that mitochondria will be

a. most numerous in cells that are least active.
b. most numerous in dead cells.
c. most numerous in cells that are most active.
d. more numerous in cells used for excretion.
e. more numerous in cells that digest food.

73. There are many shades of human skin color between light and dark. Therefore we could assume that

a. light people have more dominant genes than dark people.
b. the population contains large numbers of dark genes.
c. the differences in skin color are due to mutations in a pair of genes.
d. there is more than one pair of genes for skin color.
e. one gene is completely dominant over the other.

74. The grasslands of Australia and the grasslands of South America are similar habitats. The organisms living in these two areas often have different ancestry, but are sometimes similar in appearance and in their behavior patterns. How can we account for this?

a. Natural selection favors only a few structural and behavioral patterns.
b. Adaptations to similar environments will sometimes result in similar appearance and behavior.
c. The organisms in these areas are closely related
d. Similar patterns of behavior and appearance are only accidental.
e. Similar patterns of behavior and appearance are due to interpretations of biologists.

75. In response to environmental conditions, many lizards can spread their ribs, flatten their bodies, and orient themselves so their bodies are at right angles to the sun. What does this behavior accomplish?

a. It *increases* the surface area exposed to the sun and *lowers* body temperature.
b. It *decreases* the surface area exposed to the sun and *raises* body temperature.
c. It *decreases* the surface area exposed to the sun and *lowers* body temperature.
d. The body temperature remains the same.
e. It *increases* the surface area exposed to the sun and *raises* body temperature.

76. *Euglena* contain chloroplasts and normally require light. But microbiologists have successfully grown *euglena* in the dark in cultures to which simple sugars have been added. This implies that

a. *euglena* are descended from heterotrophic ancestors.
b. *euglena* should be classified as animals.
c. chloroplasts do not need light to function.
d. *euglena* contain enzymes for both autotrophic and heterotrophic metabolism.
e. *euglena* are not capable of photosynthesis.

77. The most important result of mitosis is that it ensures

a. the control of cellular processes by DNA.
b. the movement of raw materials from the cytoplasm to the nucleus.
c. genetic continuity from one cell to the next.
d. that RNA will form from DNA.
e. that variation will occur in the new cells.

78. *Glossopteris* is an extinct seed fern that lived during the Paleozoic era, 275–600 million years ago. Fossils of *Glossopteris* are found in India and in South Africa. Which is the best hypothesis for the presence of *Glossopteris* on both continents?

a. Large insects transported *Glossopteris* from South Africa to India
b. Humans transported *Glossopteris* from India to South Africa
c. *Glossopteris* evolved independently on both continents.
d. South Africa and India were once joined together.
e. *Glossopteris* seeds are adapted to travel in the open ocean.

79. If a mutation occurs in a segment of a DNA molecule, it is reasonable to conclude that

a. the mRNA would also be altered.
b. the mutation is helpful to the organism.
c. the tRNA would be unchanged.
d. enzyme synthesis is unchanged.
e. protein synthesis is unchanged.

80. The growth of bacterial populations resistant to antibiotics results from

a. creation of new bacterial strains by the antibiotics themselves.
b. the unsafe use of antibiotics by health-care professionals.
c. selection of naturally-occurring resistant strains.
d. a change in the strength of the antibiotics.
e. the needs of the bacteria.

END OF PART II
END OF EXAMINATION

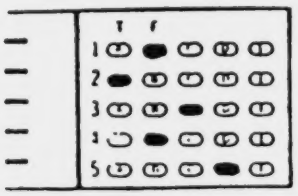
TEST DIRECTIONS

1. Please use only the No. 2 pencil provided. (A pencil sharpener is available should you need it.)

2. Please do not make marks on the test booklet. Blank paper is available for any "scratch" work that you wish to do.

3. The attached test booklet contains 64 multiple-choice items. Each item presents four responses; exactly one of the four is the correct answer.

   Read each item carefully, and select the response that you believe to be correct. On the electronic response sheet provided, fill in the oval which represents your choice of a response of "A", "B", "C", or "D" as illustrated below.



   In order to ensure that your electronic response sheet will be scored correctly, be careful to do the following.

   ** Record only one response for each item.

   ** Make heavy marks that completely fill the oval.

   ** Erase cleanly any answers you wish to change.

   ** Make no stray marks on the sheet.

4. On pages 1 and 2 of the test booklet are a Measurement Conversion Table and a Table of Geometric Formulas to which you may refer at any time during the test.

CONVERSION TABLE

METRIC LENGTH

1 kilometer = 1000 meters
1 meter = 100 centimeters
1 centimeter = 10 millimeters

CUSTOMARY LENGTH

1 mile = 1760 yards
1 mile = 5280 feet
1 yard = 3 feet
1 foot = 12 inches

METRIC AREA

1 square kilometer = 1,000,000 square meters
1 square meter = 10,000 square centimeters
1 square centimeter = 100 square millimeters

CUSTOMARY AREA

1 square yard = 9 square feet
1 square foot = 144 square inches

METRIC VOLUME AND CAPACITY

1 liter = 1000 milliliters

CUSTOMARY VOLUME AND CAPACITY

1 gallon = 4 quarts
1 quart = 2 pints
1 pint = 2 cups
1 cup = 8 ounces

METRIC WEIGHT AND MASS

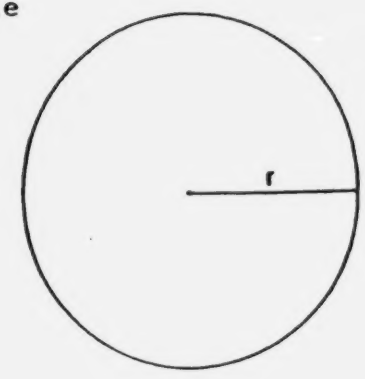
1 kilogram = 1000 grams
1 gram = 1000 milligrams

CUSTOMARY WEIGHT AND MASS

1 pound = 16 ounces

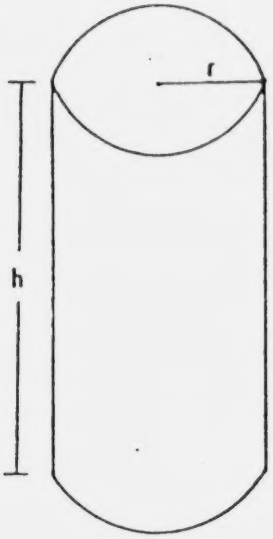
GEOMETRIC FIGURES AND FORMULAS

Circle



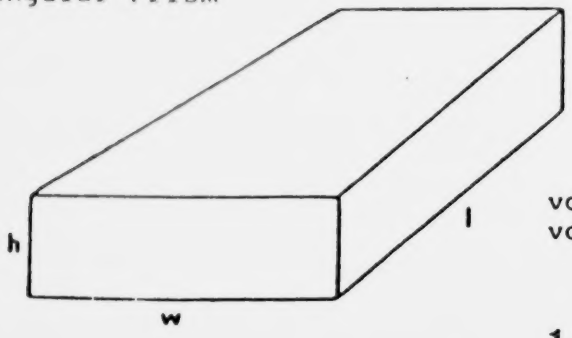
area = πr^2
where π = 3.14
circumference = $2 \pi r$ (or πd)
r = radius length
d = diameter length

Cylinder



volume = $\pi r^2 h$
where π = 3.14
r = radius length
h = height of cylinder

Rectangular Frism



volume = length x width x height
volume = lwh

1. Solve and simplify the following problem.

$5\frac{1}{8} + 1\frac{1}{4} + 4\frac{1}{2} =$

A) $10\frac{3}{14}$

B) $10\frac{7}{8}$

C) $10\frac{1}{14}$

D) $10\frac{9}{16}$

2. Select the set of numbers that is correctly ordered from least to greatest.

A) -18, -10, 0, 5

B) 0.2, 0.18, 0.076, 0.093

C) -10, -20, 30, 40

D) -25, -8, 5, 0

3. Round 48.4 to the nearest whole number.

A) 47

B) 48

C) 49

D) 50

4. Multiplying a number by $\frac{3}{8}$ is equivalent to taking which of the following percents of that number?

A) 2.67%

B) 3.75%

C) 3.8%

D) 37.5%

5. Computing 18.3% of a number is equivalent to multiplying that number by which of the following?

A) 0.183

B) 1.83

C) 183

D) 1830

6. What is the whole number equivalent of 3^0?

A) 0

B) 1

C) 3

D) It is undefined.

7. Chris is buying a camera on lay-away. She has made three payments of $12.45. The full price of the camera (including the lay-away service charge and tax) is $55.00. How much does Chris still owe on the camera?

A) $17.65

B) $27.65

C) $37.35

D) $42.55

8. Solve the following equation for the value of y.

$29 = 3y + 6$

A) $\frac{11}{3}$

B) $\frac{22}{3}$

C) $\frac{23}{3}$

D) $\frac{35}{3}$

111

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9. **Solve and simplify the following problem.**

$3\frac{1}{4} - \frac{5}{6} =$

A) $2\frac{5}{12}$

B) $2\frac{1}{2}$

C) $3\frac{5}{12}$

D) $3\frac{1}{2}$

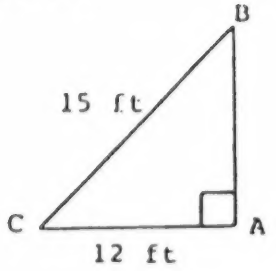
10. **What is the length of side BA?**

A) 9 ft

B) 12 ft

C) 13.5 ft

D) 27 ft



11. **Solve and simplify the following problem.**

$2\frac{5}{8} \times 2\frac{2}{5} =$

A) $4\frac{1}{4}$

B) $4\frac{7}{13}$

C) $6\frac{3}{10}$

D) $6\frac{1}{3}$

12. It takes 5 gallons of paint to cover 2 large cars. How many gallons of paint are needed to cover 14 large cars?

A) 25 gallons

B) 30 gallons

C) 35 gallons

D) 70 gallons

13. A special metal alloy is analyzed and found to be a mixture of lead, copper, and silver. Listed below are the masses of these elements found in a sample.

Type of Metal	Total Mass Found in Sample
Lead	4.9 grams
Copper	3.4 grams
Silver	1.7 grams

What percent of the sample is silver?

A) 1.7%

B) 3.4%

C) 17%

D) 34%

14. A picture has an area of 576 square inches. Determine its area in square feet.

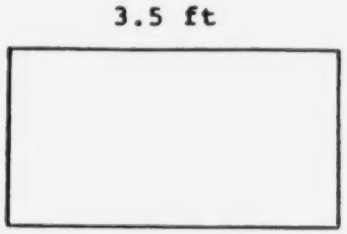
A) 4 square feet

B) 24 square feet

C) 48 square feet

D) 288 square feet

15. **Find the area of the rectangle below.**



A) 5.3 sq ft

B) 6.3 sq ft

C) 10.6 sq ft

D) 63 sq ft

16. Several students are comparing their weekly incomes from part-time jobs. What is the mean (average) amount of money earned per week by the following five students?

Student	Weekly Income
John	$38.00
Craig	$26.60
Kris	$33.60
Ellen	$20.80
Janet	$72.00

A) $38.20

B) $47.75

C) $191.00

D) $955.00

17. Lisa's school has 600 students. Next week the principal plans to select 30 students at random to answer a questionnaire. What is the probability that Lisa will be asked to answer the questionnaire?

A) $\frac{1}{600}$

B) $\frac{1}{21}$

C) $\frac{1}{20}$

D) $\frac{1}{19}$

18. Solve and simplify the following problem.

$2\frac{5}{12} \div 2\frac{1}{2} =$

A) $\frac{14}{15}$

B) $\frac{29}{30}$

C) $1\frac{1}{30}$

D) $6\frac{1}{24}$

19. **Monthly Health Insurance Rates**

Age Group	Sex	Geographic Locations		
		Area 1	Area 2	Area 3
20-24	Male	$ 36.15	$ 40.70	$ 45.20
	Female	42.60	47.95	53.35
25-30	Male	45.35	51.05	56.75
	Female	55.05	62.00	68.75
31-44	Male	59.30	66.65	74.00
	Female	67.20	75.75	84.15

Ernest Johnson's birthday is next week. He will be 25 years old. The table above shows the monthly rates charged by his health insurance company. Assuming Ernest lives in Area 2, by how much will his monthly insurance rate increase when he turns 25 years old?

A) $10.35

B) $11.35

C) $14.05

D) $51.05

20. Solve and simplify the following problem.

$$\begin{array}{r} 1\frac{3}{4} \\ +\ 6\frac{2}{5} \\ \hline \end{array}$$

A) $7\frac{3}{20}$

B) $7\frac{5}{9}$

C) $8\frac{1}{10}$

D) $8\frac{3}{20}$

21. Select the set of numbers that is correctly ordered from least to greatest.

A) 0, 0.6, 0.07, 0.008

B) -1.3, -2.6, 4.6, 7.5

C) 0.7, 0.71, 0.711, 0.702

D) -40, -37.3, 45, 45.01

22. Round 775.3 to the nearest hundred.

A) 700

B) 775

C) 780

D) 800

23. Multiplying a number by $\frac{2}{5}$ is equivalent to taking which of the following percents of that number?

A) 2%

B) 4%

C) 20%

D) 40%

24. Computing 46% of a number is equivalent to multiplying that number by which of the following?

A) 0.46

B) 4.06

C) 4.6

D) 46

25. What is the whole number equivalent of 0^7?

A) 0

B) 1

C) 7

D) It is undefined.

26. A neighborhood baseball team of 9 players bought 12 balls at $3.75 each and 7 bats at $13.95 each. What was the total cost of the balls and the bats?

A) $15.85

B) $17.70

C) $142.65

D) $336.30

27. Solve the following equation for the value of k.

$\frac{1}{7}k = 3.5$

A) 0.5

B) 3.5

C) 4.2

D) 24.5

28. Solve and simplify the following problem.

$$\begin{array}{r} 9\frac{1}{4} \\ -\,7\frac{5}{6} \\ \hline \end{array}$$

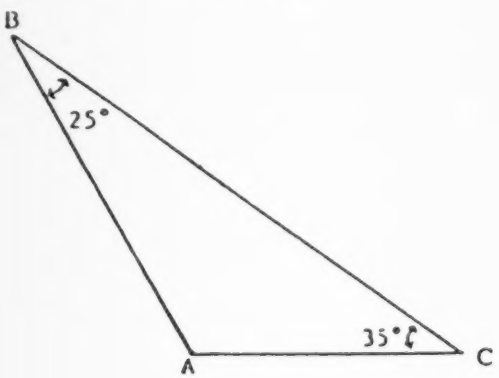
A) $1\frac{5}{12}$

B) $1\frac{1}{2}$

C) $2\frac{5}{12}$

D) $2\frac{1}{2}$

29. What is the measure of angle BAC?



A) 30°

B) 120°

C) 130°

D) 300°

30. Solve and simplify the following problem.

$\frac{5}{6} \times 4\frac{1}{3} =$

A) $3\frac{1}{3}$

B) $3\frac{11}{18}$

C) $4\frac{5}{18}$

D) $5\frac{1}{6}$

31. A gardener was told that she should apply 7 pounds of insecticide for every 950 square feet of lawn. If her lawn has an area of 7600 square feet, what minimum amount of insecticide does she need?

A) 49 pounds

B) 54 pounds

C) 56 pounds

D) 66.5 pounds

32. A car dealer wants to increase his sales by 5% over last year's sales. If he sold 180 cars last year, how many additional cars must he sell this year?

A) 9

B) 45

C) 90

D) 189

33. Maria purchased a roll of tape that has 5 yards 2 feet of tape in it. How many feet of tape is this?

A) 15 feet

B) 17 feet

C) 52 feet

D) 62 feet

34. The Williams family has a garden in the shape of a right triangle. The length of the sides of the garden which form the right angle are 15 feet and 36 feet. The length of the other side is 39 feet. In order to buy enough fertilizer for the garden, they need to know how many square feet are contained in it. Find the number of square feet in the garden.

A) 270 sq ft

B) 292.5 sq ft

C) 540 sq ft

D) 702 sq ft

35. The wheat yields (in bushels per acre) for a five-county survey were as follows: Akron County, 48; Bluefoot County, 51; Cole County, 62; Door County, 57; and Essex County, 62. Determine the mean (average) of these wheat yields.

A) 56 bushels per acre

B) 57 bushels per acre

C) 62 bushels per acre

D) 70 bushels per acre

36. Sam bought 6 tickets in a raffle for a Thanksgiving turkey. If a total of 420 tickets were sold for the raffle, what is the probability of Sam's winning the turkey?

A) $\frac{1}{420}$

B) $\frac{1}{70}$

C) $\frac{1}{69}$

D) $\frac{1}{6}$

37. Solve and simplify the following problem.

$\frac{2}{3} \div 4\frac{2}{15} =$

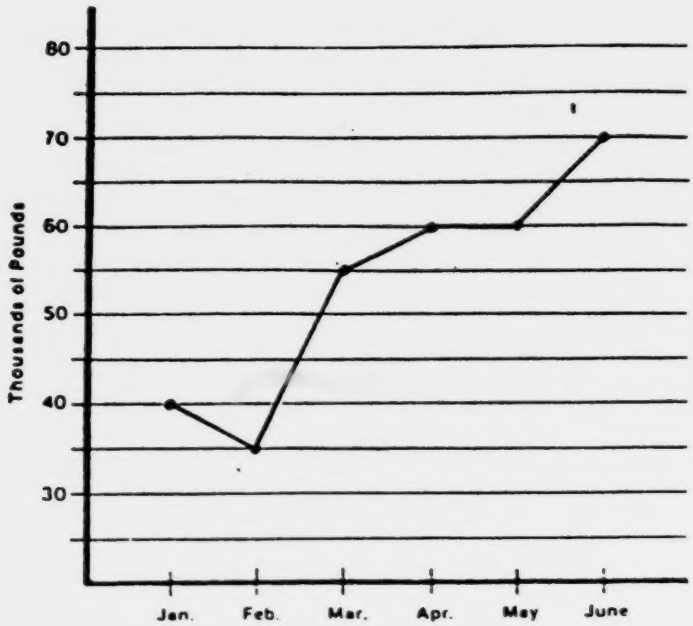
A) $\frac{5}{31}$

B) $\frac{1}{6}$

C) $2\frac{34}{45}$

D) $6\frac{1}{5}$

38. **Semi-Annual Production Report**



What was the average production for February, March, and April?

A) 47.5 thousand pounds

B) 50 thousand pounds

C) 75 thousand pounds

D) 150 thousand pounds

39. Select the set of numbers that is correctly ordered from least to greatest.

A) 983, 305, 827, 671

B) 7, 8, 9, 9.1

C) 43, 85, 95.6, -100

D) 14, 18, -24.1, -32.5

40. Round 33.852 to the nearest tenth.

A) 33.062

B) 33.8

C) 33.85

D) 33.9

41. Courtney pays her parents for her long-distance telephone calls. For calling Dallas, she was charged $.45 per minute for the first five minutes; each additional minute cost $.30. The total charge for the call was $6.75. How long did she speak?

A) 9 minutes

B) 15 minutes

C) 20 minutes

D) 21 minutes

42. What is the whole number equivalent of 0^0?

A) 0

B) 1

C) 10

D) It is undefined.

43. Solve the following equation for the value of g.

$12g + 0.8 = 8$

A) 0.6

B) 6

C) 19.2

D) 20.8

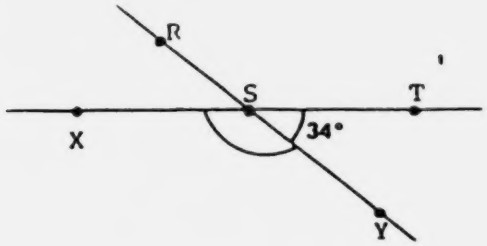
44. Determine the measure of angle XSY.

A) 34°

B) 56°

C) 146°

D) 326°



45. Mr. Ramos can make 7 batches of doughnuts in 3 hours. If he needs 21 batches of doughnuts, how long will he need to work?

A) 9 hours

B) 21 hours

C) 63 hours

D) 147 hours

46. Representatives of a local college reported that 40% of the applicants were accepted for the coming year. If 2600 students applied, how many were accepted?

A) 65

B) 104

C) 1040

D) 1240

47. Determine the volume of a water tank that is in the shape of a right circular cylinder. The tank is 20.0 feet high and has a radius of 10.0 feet.

A) 200 π or 628 cu ft

B) 400 π or 1256 cu ft

C) 500 π or 1570 cu ft

D) 2000 π or 6280 cu ft

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48. A jar of jam is labeled as having a mass of 480 grams. How many kilograms is this?

A) 0.48 kilograms

B) 3 kilograms

C) 30 kilograms

D) 4800 kilograms

49. The points scored by the Seacrest High School football team during the beginning of last year's season were as follows:

12, 20, 0, 31, 17

What was the mean (average) number of points scored?

A) 0 points

B) 16 points

C) 17 points

D) 20 points

50. In a certain game, players must answer trivia questions that are written on cards. Each card has a single question. When it is your turn to draw a card, the deck contains:

30 questions about science
15 questions about sports
45 questions about art
90 questions about history

What is the probability that you will draw a question about science?

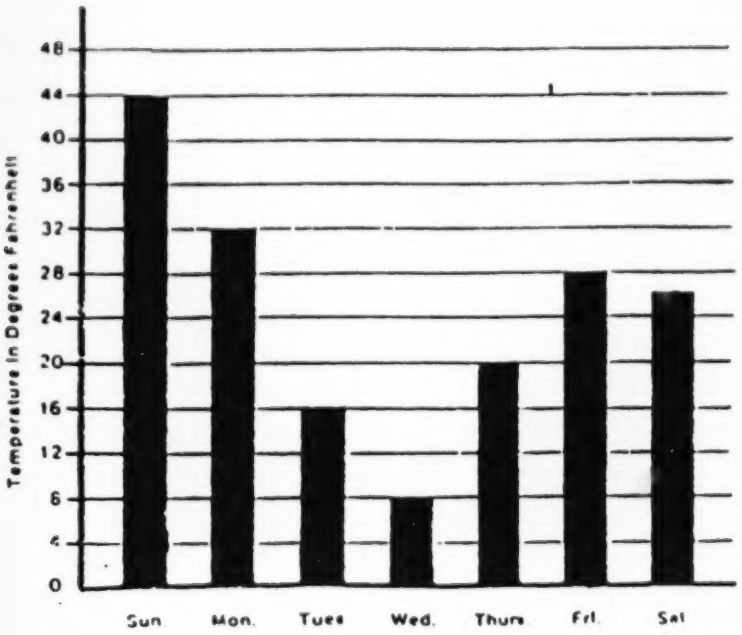
A) $\frac{1}{6}$

B) $\frac{1}{4}$

C) $\frac{3}{4}$

D) $\frac{5}{6}$

51. Daily High Temperatures



What is the average high temperature for Monday through Friday?

A) 20 degrees Fahrenheit

B) 20.8 degrees Fahrenheit

C) 25 degrees Fahrenheit

D) 104 degrees Fahrenheit

52. Select the set of numbers that is correctly ordered from least to greatest.

A) -4.5, -4.32, 0, 14

B) 9.8, 9.86, 9.9, 0.10

C) 27, 29, 26, 40

D) 6.4, 6.25, 6.327, 6.489

53. Round 0.394 to the nearest hundredth.

A) 0.094

B) 0.39

C) 0.394

D) 0.40

54. One-fourth of the boys and one-fifth of the girls in the eleventh grade participate in sports. There are 95 girls and 104 boys in the eleventh grade. What is the total number of eleventh grade students participating in sports?

A) 26

B) 44

C) 45

D) 154

55. What is the whole number equivalent of 10^0?

A) 0

B) 1

C) 10

D) It is undefined.

56. Solve the following equation for the value of m.

$7.2 = 4(m + .9)$

A) 0.9

B) 1.575

C) 2.3

D) 9

57. You are planning an after-game party. The owner of the pizza parlor recommends that you purchase 2 large pizzas for every 7 people. What should you buy in order to feed 35 people?

A) 5 pizzas

B) 7 pizzas

C) 10 pizzas

D) 14 pizzas

58. Of the 60 calves born on Mr. King's ranch this spring, 12 had white faces. What percent of the calves born this spring had white faces?

A) 5%

B) 12%

C) 20%

D) 72%

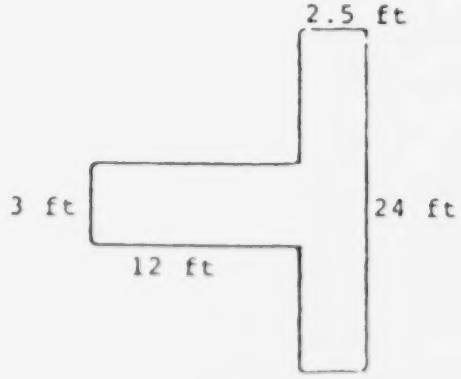
59. Find the perimeter of the irregular shape. (All angles are right angles.)

A) 41.5 ft

B) 56 ft

C) 77 ft

D) 96 ft



60. Mr. Simpson works at home and reports his hours to his employer. On Tuesday, he worked on three different projects. The time he spent on each project is as follows:

Project A:	2 hours	35 minutes
Project B:	1 hour	28 minutes
Project C:	4 hours	45 minutes

What is the total amount of time Mr. Simpson worked on Tuesday?

A) 7 hours 8 minutes

B) 7 hours 48 minutes

C) 8 hours 8 minutes

D) 8 hours 48 minutes

61. On certain days of the week, a runner records her best time (in seconds) for the 100-meter dash. One week she records the following times:

12.2, 12.6, 12.4, 12.2, 14.6

What was the mean (average) of the times she recorded that week?

A) 12.2 seconds

B) 12.4 seconds

C) 12.8 seconds

D) 64.0 seconds

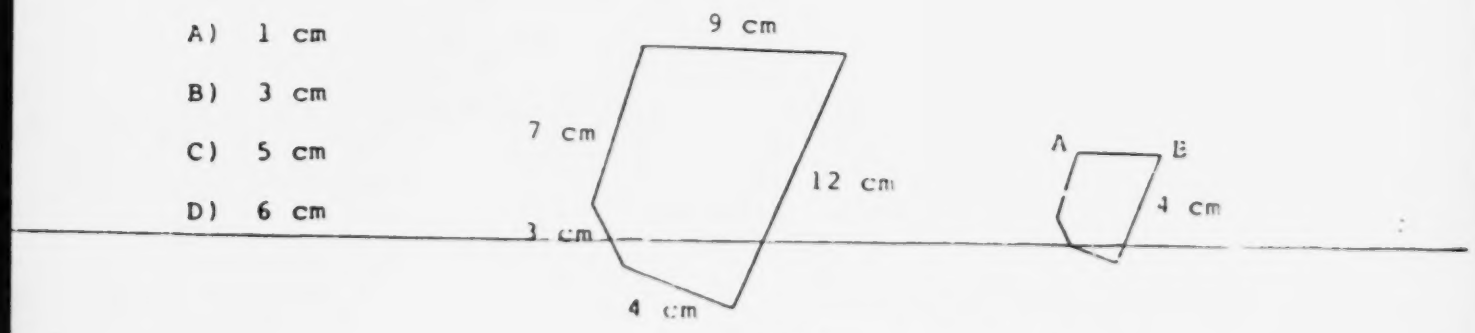
62. The figures below are similar. What is the length of side AB of the smaller figure?

A) 1 cm

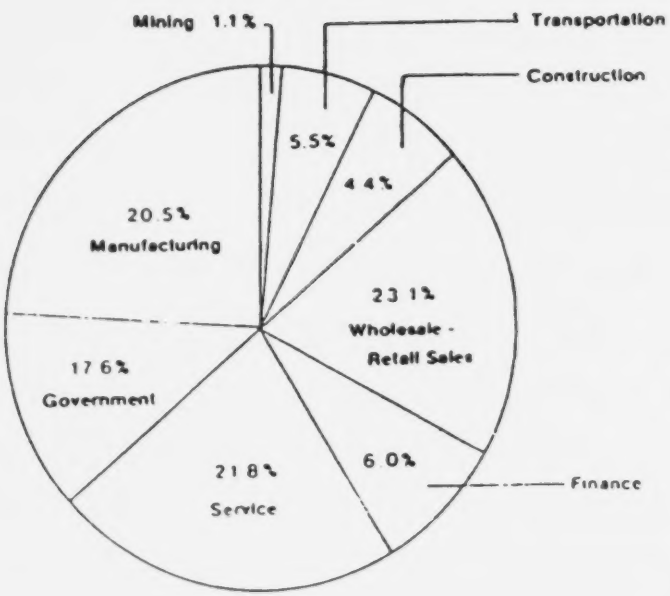
B) 3 cm

C) 5 cm

D) 6 cm



63. Non-Farm Workers



What total percentage of the non-farm work force is involved in service, government, or wholesale-retail sales?

A) 37.5%

B) 44.9%

C) 50.9%

D) 62.5%

64. At a school carnival, student teams compete at answering mathematics problems. The winning team selects its prize from a collection of identically shaped boxes. Each box contains one prize, but the values of the prizes differ.

1 prize is worth $250
2 prizes are worth $100 each
4 prizes are worth $50 each
5 prizes are worth $25 each

What is the probability that a team will select a prize worth more than $50?

A) $\frac{1}{4}$

B) $\frac{1}{3}$

C) $\frac{7}{12}$

D) $\frac{5}{7}$

Physical Science Test

Directions:

The following test consists of 40 multiple choice test items addressing a number of topics in physical science. Each question has four answer choices. Your tasks are to select the best answer then fill in the answer sheet (blue sheet) with the appropriate letter. Please use a pencil with soft lead.

Example

50. The chemical formula for water is:

A. NaCl
B. HCl
C. H_2O
D. CH_4

Since the answer is C, shade in choice c on the answer sheet for item 50.

50. (A) (B) (C) (D) (E)

1. What is the best piece of equipment to use to measure the mass of a steel ball?

   A. beaker
   B. triple beam balance
   C. tongs
   D. meter stick

2. When using electrical equipment, the safest procedure would be to:

   A. take the equipment apart if it fails to operate.
   B. work in a wet area.
   C. yank the cord to unplug it.
   D. check the electric cord for breaks in the insulation before plugging it in.

3. If you were transported to the moon, which of the following would change?

   A. your mass
   B. your weight
   C. both
   D. neither

4. The poles of two magnets are near each other and repel. The poles could <u>not</u> be:

   A. two north poles
   B. a north and a south pole
   C. two south poles
   D. both A and C

5. The kinetic energy of a ball dropped from a height of 25 meters is greatest at a height of _____ meters.

   A. 20
   B. 10
   C. 2
   D. at any height

6. The potential energy of a ball dropped from a height of 25 meters is least at a height of _____ meters.

   A. 20
   B. 10
   C. 2
   D. at any height

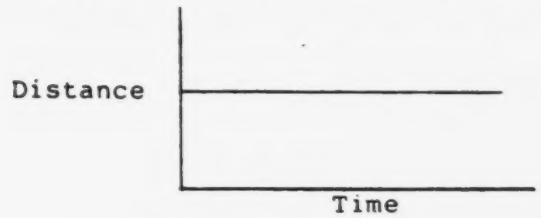
7. The tendency of a moving object to keep moving is called,

   A. acceleration
   B. resistance
   C. velocity
   D. inertia

8. The unit for force is:

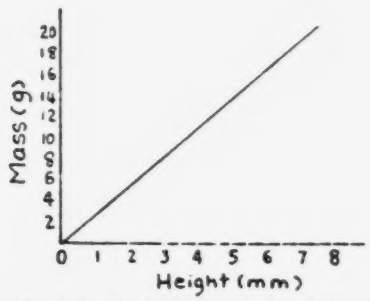
A. watt
B. joule
C. newton
D. gram

9. Interpret the following graph:



A. Represents a car accelerating.
B. Represents a car standing still.
C. Represents a car moving a constant speed.
D. Represents a car slowing down (decelerating).

10. After weighing and measuring the height of several different sized stacks of pennies, we plotted the following graph of mass vs. height. The graph shows that:



A. as the height increased the mass increased
B. as the mass increased the height decreased
C. as the mass decreased the height increased
D. as the height decreased the mass increased

11. Copper is used for wiring in homes because of its

A. electrical conductivity
B. brittleness
C. maleability
D. color

12. The primary purpose of a machine is to:

A. multiply work
B. create energy
C. multiply force
D. create work

13. Which of the following simple machines does a flight of stairs represent?

A. lever
B. pulley
C. axle
D. inclined plane

14. Which of the following is an explanation of why an electrician wears insulated shoes?

A. The insulated shoes prevent the flow of electrons through the electrician's body.
B. The insulated shoes allow for the flow of electrons through the electrician's body.
C. There is no source for electron flow.
D. Insulated shoes are more comfortable.

15. In the metric system, which of the following represents the unit of length?

A. liter
B. gram
C. celsius
D. meter

16. Which lab procedure is unsafe?

A. point test tube away from people when heating
B. heating a closed container
C. set up equipment away from edge of desk
D. handle poisonous gases under the hood

17. Since acid is heavier than water, when mixing water and acid you should

A. pour both at the same time and shake.
B. add water to the concentrated acid.
C. add concentrated acid slowly to the water.
D. never mix an acid with water.

18. Which of the following situations describes a chemical property?

A. melting point
B. boiling point
C. reacts with oxygen
D. density of an substance

19. A change that produces a new substance with new properties is:

A. ice melting
B. chemical
C. physical
D. water boiling

20. Which of the following is a physical change?

A. change from the liquid to the solid state.
B. when the composition of the material is changed.
C. changes involving the release of heat or light.
D. water decomposed by electricity into hydrogen and oxygen.

21. Which compound does not belong?

A. H_2SO_4
B. NaOH
C. H_2CO_3
D. HCl

22. The compound NaCl is called:

A. sodium chloride
B. calcium chloride
C. chlorine
D. silver chloride

23. Which of the following elements does not belong with the others?

A. Magnesium
B. Copper
C. Chlorine
D. Silver

24. Two different powdered substances were observed. Substance A is white, smooth, minute particles. Substance B is clear, rough, square-shaped particles. This information could be used to determine:

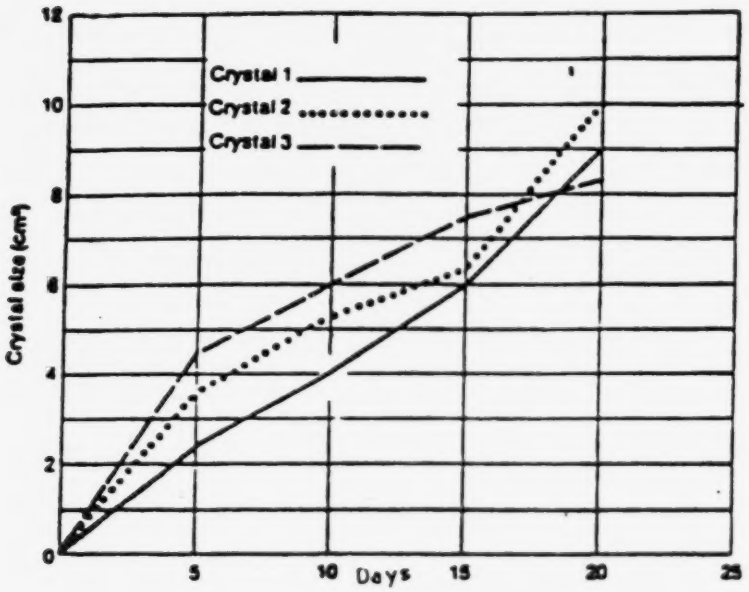
A. the name of Substance A is baking soda and Substance B is sugar.
B. the physical characteristics of substance A and B
C. the chemical characteristics of substance A and B
D. the name of Substance A is flour and Substance B is salt crystals.

25. The boiling point is the temperature at which a substance changes from

A. solid to liquid
B. liquid to gas
C. solid to gas
D. liquid to solid

26. To find the density of a substance you must know its mass and

A. volume
B. weight
C. composition
D. shape



Use the graph above to answer the following 3 questions.

27. Over how many days were the crystals observed?

    A. 5 days
    B. 10 days
    C. 20 days
    D. 15 days

28. Crystal 1 grew most rapidly during which time interval?

    A. 0-5 days
    B. 5-10 days
    C. 10-15 days
    D. 15-20 days

29. A conclusion from the data on the graph could be

    A. crystal 1 and 2 grew at the same rate
    B. crystal 2 grew the largest
    C. crystal 1 grew the largest
    D. crystal 3 grew the largest

30. An acid + base yields water + _____.

A. base
B. acid
C. salt
D. none of the above

31. One clear liquid and one red liquid are combined in a test tube. The clear liquid floats on top of the red. You can definitely conclude:

A. that one is an acid.
B. that the clear liquid is less dense than the red.
C. that the red liquid is less dense than the clear.
D. nothing.

32. A tin sample has a volume of 10 mL and a mass of 35 grams. If the formula for density is density = mass/volume, find the density of tin.

A. 2.8 g/mL
B. 3.5 g/mL
C. 35 g/mL
D. 350 g/mL

33. When a physical change occurs,

A. the size of a substance may change.
B. the substance's identity remains the same.
C. a new substance is formed.
D. answers A and B are correct.

34. If something has mass and takes up space, it

A. is matter.
B. must be a gas.
C. is in the liquid state.
D. is always a solid.

35. An acid and base are mixed together. A white powdery substance settles to the bottom. This white substance is a _____.

A. condensation
B. filter
C. precipitate
D. solution

36. An acidic solution could have a pH of

A. 5
B. 7
C. 9
D. 11

37. A household product that could be used to neutralize an acid burn is

A. lemon juice
B. vinegar
C. ammonia
D. grated carrots

38. The bubbles you see when a bottle of soda is opened indicate:

A. gases being released
B. precipitate being formed
C. a sugar
D. an acid

39. Tongs are used to:

A. stir chemicals
B. crush powders
C. hold hot objects
D. heat crucibles

40. Which of the following types of equipment could best be used to stir, pour, and heat liquids?

A. graduated cylinder
B. beaker
C. evaporating dish
D. Erlenmeyer flask

Earth Science Test

Directions:

The following test consists of 60 multiple choice test items addressing a number of topics in earth science. Each question has four answer choices. Your tasks are to select the best answer then fill in the answer sheet (blue sheet) with the appropriate letter. Please use a pencil with soft lead.

Example

65. The chemical formula for water is:

A. NaCl
B. HCl
C. H_2O
D. CH_4

Since the answer is C, shade in choice c on the answer sheet for item 65.

65. (A) (B) (C) (D) (E)

EARTH SCIENCE CONCEPT ATTAINMENT

1. Identify the major cause of the seasons:

   a. the revolution of the sun
   b. the rotation of the Earth every 24 hours
   c. the gravitational pull of the sun and moon on the Earth
   d. the 23 1/2° tilt of the Earth's axis

2. Which of these types of solar energy DO NOT affect the Earth?

   a. solar friction
   b. infrared radiation
   c. light
   d. heat

3. An example of a process that changes the Earth is:

   a. ecology b. weathering c. environment d. magnetism

4. All of the following are examples of energy caused directly or indirectly by the sun EXCEPT:

   a. heat energy
   b. light energy
   c. fossil fuel
   d. geothermal energy (geysers)

5. What season occurs in the northern hemisphere when the rays of the sun are more nearly vertical in the southern hemisphere?

   a. summer b. spring c. winter d. fall

6. What is a major product of solar energy which reaches the Earth?

   a. light radiation
   b. solar storms
   c. corona prominences
   d. gas energy

7. Long days and short nights in the United States are characteristic of?

   a. summer
   b. Indian summer
   c. winter
   d. monsoon season

8. What is true about solar energy and other energy sources?

   a. solar energy can be used to replace other sources of energy
   b. Solar energy cannot replace other energy sources
   c. Solar energy, as well as other energy sources, can be conserved
   d. other energy sources should be used to conserve solar energy

9. Man and the environment are interdependent and influence each other. Which of the following is NOT dependent on man?

   a. oceans b. plant life c. gravity d. soil

10. Another cause of the seasons, in addition to the tilt of the Earth's axis, is:

   a. the twenty-hour rotation cycle of the Earth
   b. the distance the Earth is from the sun
   c. the revolution of the Earth around the sun
   d. the gravitational pull of the moon on the Earth

11. The interdependence of man and the environment means:

   a. man is not related to other living organisms that live on the Earth
   b. man and the environment are influenced and affected by each other
   c. man has the ability to change the total environment
   d. the environment is not affected by man

12. Which of these phenomena DO NOT cause the Earth to change?

   a. friction b. weather c. the northern lights d. gravity

13. The primary source of almost all of the energy available on the surface of the Earth is:

   a. water currents b. electricity
   c. the sun d. the wind

14. Which of the following shows that the Earth is always changing its surface?

   a. the forming of mountains
   b. the shifting of the magnetic poles
   c. the cycle of the tides
   d. the gravity of the Earth

15. The Earth turning on its axis every 24 hours causes:

   a. momentum and inertia
   b. friction and gravity
   c. occultation and perturbation
   d. day and night

16. Man's effect on the environment is shown by:

a. an earthquake in south Texas
b. a forest fire caused by lightning
c. a hurricane on the Texas coast
d. fertilizing more land to grow more food

17. Most of the changes in the Earth's surface can be described as:

a. deposition and erosion
b. composition of new elements
c. matter being broken down and destroyed
d. the Earth becoming smaller

18. Because man has an influence on the Earth's environment, he needs to:

a. rapidly consume the present natural resources
b. control all of the natural resources in the environment
c. replace the petroleum he has used
d. use all the resources in the environment conservatively

19. Coal is a result of energy that comes indirectly from:

a. river beds
b. mines
c. solar energy
d. animal fossils

20. A cause for both the seasons and day and night is:

a. the motion of other planets
b. the motion of the moon
c. the motion of the Earth
d. the motion of the sun

21. Which is always a cause of day and night?

a. the revolution of the moon around the Earth
b. the revolution of the Earth around the sun
c. the rotation of the sun on its axis
d. the rotation of the Earth on its axis

22. Which of the following IS NOT a cause of the seasons?

a. the Earth turning from east to west
b. the inclination of the Earth's axis
c. the Earth's revolution around the sun
d. the sun providing a continuous source of light

23. Which of the following IS NOT a phenomena that changes the Earth?

a. earthquakes
b. stream erosion
c. moonquakes
d. weathering

24. Man's relationship with the environment is one of:

a. perfection
b. independence
c. irrelevance
d. interdependence

25. What IS NOT true about the effect of man on the environment?

a. pollution of air and water are problems man has created in the environment
b. man has on occasion been wasteful of the Earth's resources
c. the environment is self-healing and is not affected by man
d. the U.S. government has enacted laws to help protect the environment

26. A decrease of air pollution in several large cities has resulted from:

a. plants adding oxygen to the air
b. the environment's ability to clean up the pollutants
c. man's decision to clean up the air
d. animals adding carbon dioxide to the air

27. The relationship of solar energy and man's interdependence on the environment can be shown by man's:

a. use of solar energy to conserve fuel sources
b. inability to use solar energy for fuel
c. expensive waste of solar energy
d. discovery that solar energy cannot be used

28. Which of the following is true for both the seasons and the climate?

a. the longer the season, the hotter the climate will be
b. the colder the climate, the hotter the season will be
c. seasons and climate receive energy from the atmosphere
d. seasons and climate are affected by the sun

29. What effect does man's attempt to find new energy sources have on the environment?

a. there is no effect
b. the environment is better protected
c. man improves the environment
d. the environment will change

30. What is true for all seasons?

a. summer occurs at the same date in the northern and southern hemispheres
b. seasons are a major cause of solar flares
c. seasons occur periodically
d. seasons cause the aurora borealis, which is seen only in the winter

31. What is the major cause for day and night?

a. the earth revolving around the sun
b. the sun rotating on its axis
c. the Earth rotating on its axis
d. the moon revolving around the Earth

32. Solar radiation is an example of:

a. mass b. momentum c. energy d. friction

33. Heat energy from the sun affects:

a. the surface temperature of the Earth
b. the rise and fall of ocean tides
c. the internal temperature of the Earth
d. the volcanic eruptions of the Earth

34. The tilt of the Earth's axis and the Earth's orbit around the sun cause:

a. solar flares b. seasons c. sun spots d. 24-hour day

35. Which of the following DOES NOT affect day and night?

a. the sun acting as a source of light
b. the inclination of the Earth's axis
c. the west to east direction the sun turns
d. the rotation of the Earth on its axis

36. A major cause for the continuous change of the Earth's surface is:

a. the rotation of the Earth
b. the weathering process
c. the twelve month year
d. the twenty-four hour day

37. The Earth rotates on its axis. This turning produces:

a. seasons
b. eclipse of the moon
c. eclipse of the sun
d. day and night

38. The tilt of the Earth's axis is a cause of:

a. the Coriolis Parameter
b. earthquakes
c. day and night
d. the seasons

39. This picture shows:

a. a planet rotating on its axis
b. the equinox in December
c. the force of gravity
d. a sideral day in July

40. During January in the northern hemisphere, which of the following is true?

a. the direct rays of the sun are on the Tropic of Cancer
b. the nights are longer and the days are shorter
c. the tilt of the Earth's axis is changed to 75°
d. the days and nights are almost equal in length

41. Solar energy is important to the Earth because it:

a. directly supplies all the radiant energy used in atomic reactors
b. heats the Earth more in the winter than in the summer
c. cannot be converted to heat energy to warm homes
d. directly or indirectly supplies almost all the energy on the surface of the Earth

42. Interdependence between man and the environment is:

a. limited to air and water
b. limited to living things, like plants and animals
c. inclusive of both living and nonliving things
d. inclusive of only energy sources, like oil and gas

43. What is true about water erosion's effect on the Earth?

a. it keeps the water from draining into the sea
b. it causes the earth to build up everywhere
c. it takes the harmful chemicals out of drinking water
d. it causes a continual change in the Earth's surface

44. An example of man's effect on the environment is:

a. light b. temperature c. climate d. drained swamp

45. Day and night on the earth, except for the equinox, are different in length because:

a. the Earth's axis is tilted
b. the gravitational force of the Earth increases
c. the Earth's axis is perpendicular
d. the Earth turns at a speed of 66,000 miles per hour

46. Which IS NOT true about the seasons?

a. seasons occur in the same order each year
b. seasons are a major cause of magnetic storms
c. seasons are caused by the orbit of the Earth around the sun
d. seasons are caused by the tilt of the Earth's axis

47. Which of the following is a cause of day and night?

a. the moon's reflected light
b. the sun's revolution
c. the moon's revolution
d. the Earth's rotation

48. A river valley is an example of a geological feature caused by:

a. a river delta b. stream erosion
c. an earthquake d. volcanic action

49. The Earth has been undergoing change since its formation billions of years ago. Which of the following does this suggest?

a. the oceans are a major cause of land change
b. the interior of the Earth is fixed and unchanging
c. landforms have been built up and worn down many times
d. glaciers are the major force that cause surface change

50. We know the rotation of the Earth produces periods of light and dark. These periods are identified as:

a. day and night b. summer and winter
c. seasons d. rain and drougnt

51. Which of the following is the correct combination of causes for the seasons:

a. distance from the sun, climate, and tilt of the Earth's axis
b. rotation of the Earth, weather, and climate
c. weather, revolution of the Earth around the sun, and rotation of the Earth
d. inclination (tilt) of the Earth's axis and revolution of the Earth around the sun

52. Which of the following is the cause of day and night?

a. the Earth's rotation around its axis
b. the Earth's revolution around the sun
c. the moon's direct rays
d. the sun's rotation

53. Select an example of indirect solar energy:

a. mixing acid and a metal
b. turning on a flashlight
c. burning a wood fire
d. molten lava

54. The environment has an influence on man's food, clothing, and water; man has an effect on the environment. Which of the following is an illustration?

a. man has totally polluted the environment
b. man has caused the weather to change
c. the environment is totally dependent on man
d. the environment and man are interdependent

55. Green plants use the sun's energy to change carbon dioxide and water into food. What type of energy is used?

a. light b. plasma c. heat d. fission

56. The phenomena of erosion, deposition, faulting, weathering, and earthquakes have been going on for billions of years. This results in:

a. the Earth remaining the same
b. the Earth constantly changing
c. the oceans not being affected by these changes
d. the Earth expanding

57. Solar energy provides the Earth with:

a. radioactive elements
b. water
c. air
d. light

58. Erosion changes the Earth's surface. Which of the following is an example of erosion?

a. volcanoes
b. salt domes
c. river canyons
d. fault zones

59. What is true for the Earth and for an individual's environment?

a. as the Earth remains unchanging, the environment remains the same
b. both the earth and the environment are changing
c. as the Earth changes, the environment remains constant
d. as the Earth remains the same, the environment remains the same

60. Which of the following IS NOT a cause of day and night?

a. the rotation of the Earth
b. the Earth turning on its axis
c. the Earth's distance from the sun
d. the sun providing a constant source of light